US009675122B2

(12) **United States Patent**
Turner

(10) **Patent No.: US 9,675,122 B2**
(45) **Date of Patent: *Jun. 13, 2017**

(54) **APPAREL INCORPORATING A PROTECTIVE ELEMENT**

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(73) Assignee: **NIKE, Inc.**, Beaverton, OR (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/874,161**

(22) Filed: **Oct. 2, 2015**

(65) **Prior Publication Data**

US 2016/0021953 A1 Jan. 28, 2016

Related U.S. Application Data

(63) Continuation-in-part of application No. 13/927,436, filed on Jun. 26, 2013, now Pat. No. 9,149,084, which (Continued)

(51) **Int. Cl.**

A41D 13/015	(2006.01)
A41D 13/05	(2006.01)
A41D 13/00	(2006.01)

(52) **U.S. Cl.**

CPC ***A41D 13/0543*** (2013.01); ***A41D 13/015*** (2013.01); ***A41D 13/0512*** (2013.01); ***A41D 13/0562*** (2013.01)

(58) **Field of Classification Search**

CPC .. A41D 13/0153; A41D 13/05; A41D 13/015; A41D 13/0562; A41D 13/0568; A41D 13/0593; A41D 13/0015; A41D 13/0543; A41D 13/0587; A41D 13/0506; A41D 13/0581; A41D 13/065; A41D 13/0156; A41D 13/01; A41D 13/0556; A41D 13/0575; A41D 13/08; A41D 13/02; A41D 1/06; A41D 1/082; A41D 2300/20;

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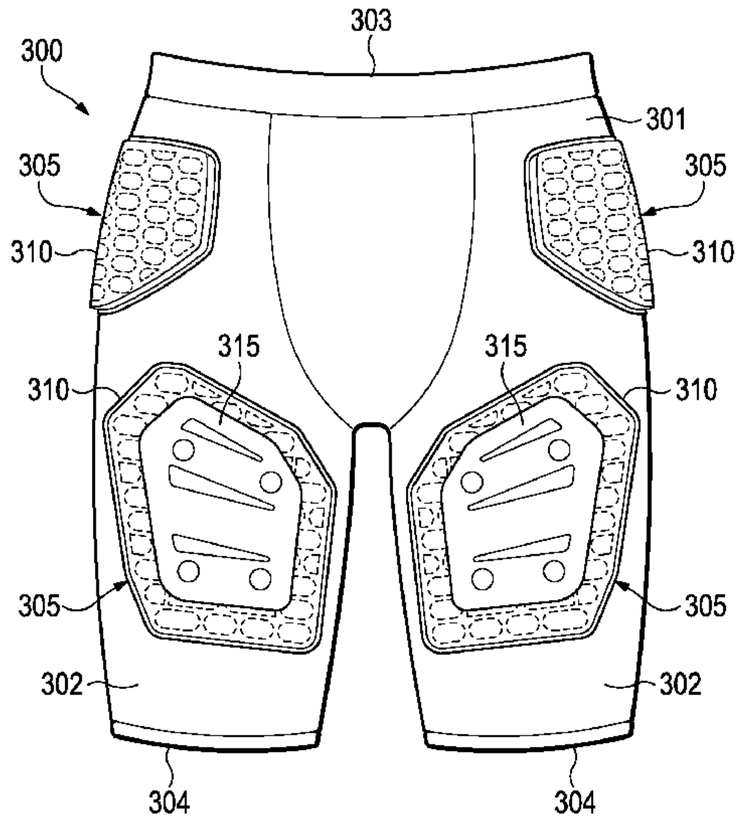
(74) *Attorney, Agent, or Firm* — Shook, Hardy & Bacon L.L.P.

(57) **ABSTRACT**

Protective components may include a plate element and a cushioning element that are secured together with a hook-and-loop fastening system. The cushioning element may include a pair of material layers and a pad or a plurality of pad components located between the material layers. The plate element may include a polymer material and the pad may include a polymer foam material.

16 Claims, 41 Drawing Sheets



Related U.S. Application Data

is a continuation-in-part of application No. 13/889,018, filed on May 7, 2013, now Pat. No. 8,713,719, which is a continuation of application No. 13/111,461, filed on May 19, 2011, now Pat. No. 8,438,669, which is a continuation-in-part of application No. 12/490,001, filed on Jun. 23, 2009, now Pat. No. 8,095,996.

(58) **Field of Classification Search**

CPC .. A41D 31/005; A41D 13/00; A41D 13/0002; A41D 19/01523; A41D 1/08; A41D 27/00; A63B 2071/125; A63B 2071/1208; A63B 71/1225; A63B 71/08; A63B 2071/1233; A63B 2209/10; A63B 2243/0041; A63B 71/143

USPC ..... 2/2, 16, 22, 24, 267, 268, 243 R, 243 A, 2/DIG. 1, 44, 45; 128/89 R, 156, 157

See application file for complete search history.

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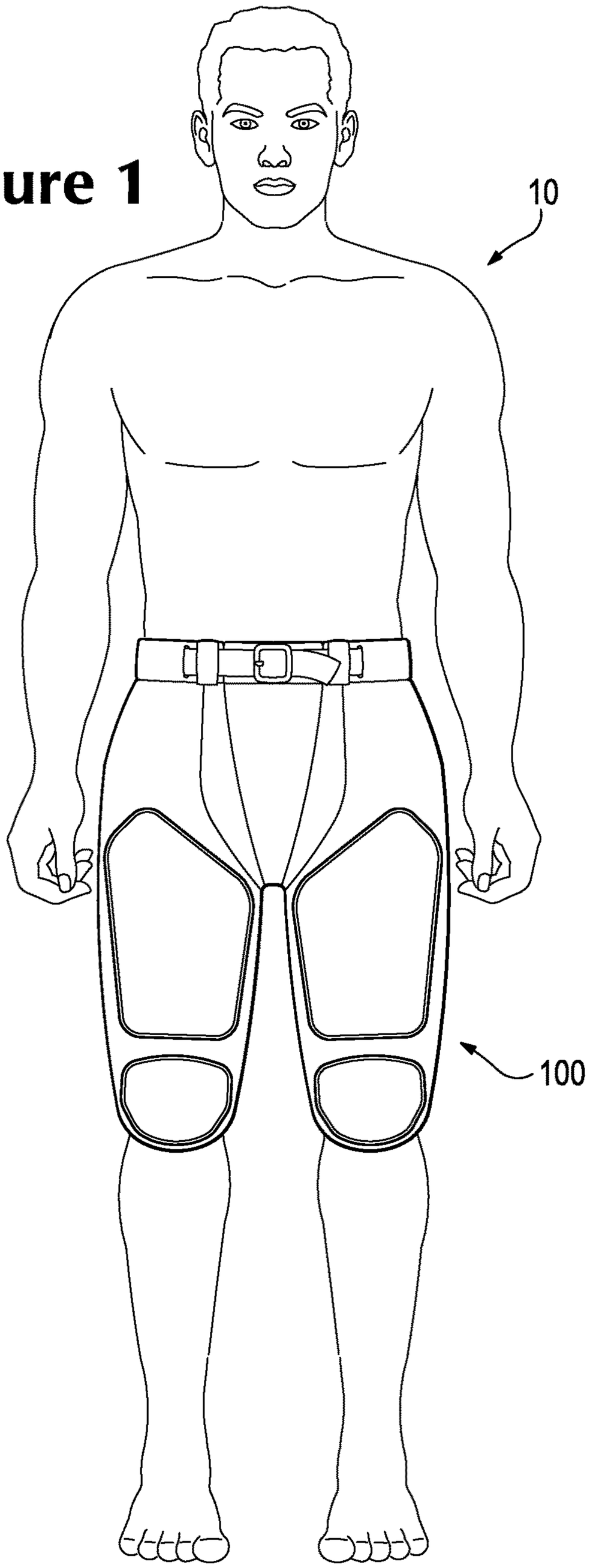
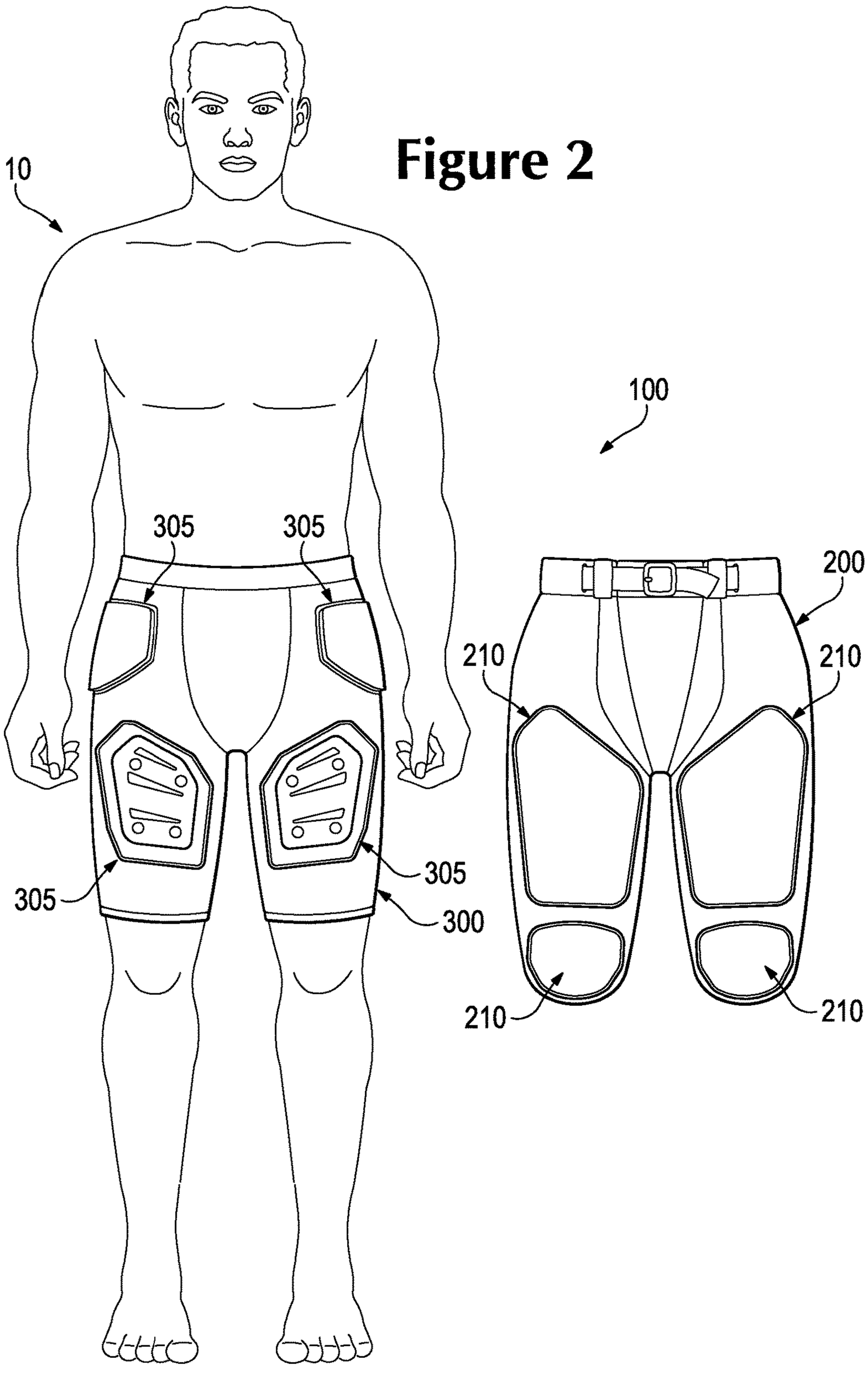
Figure 1





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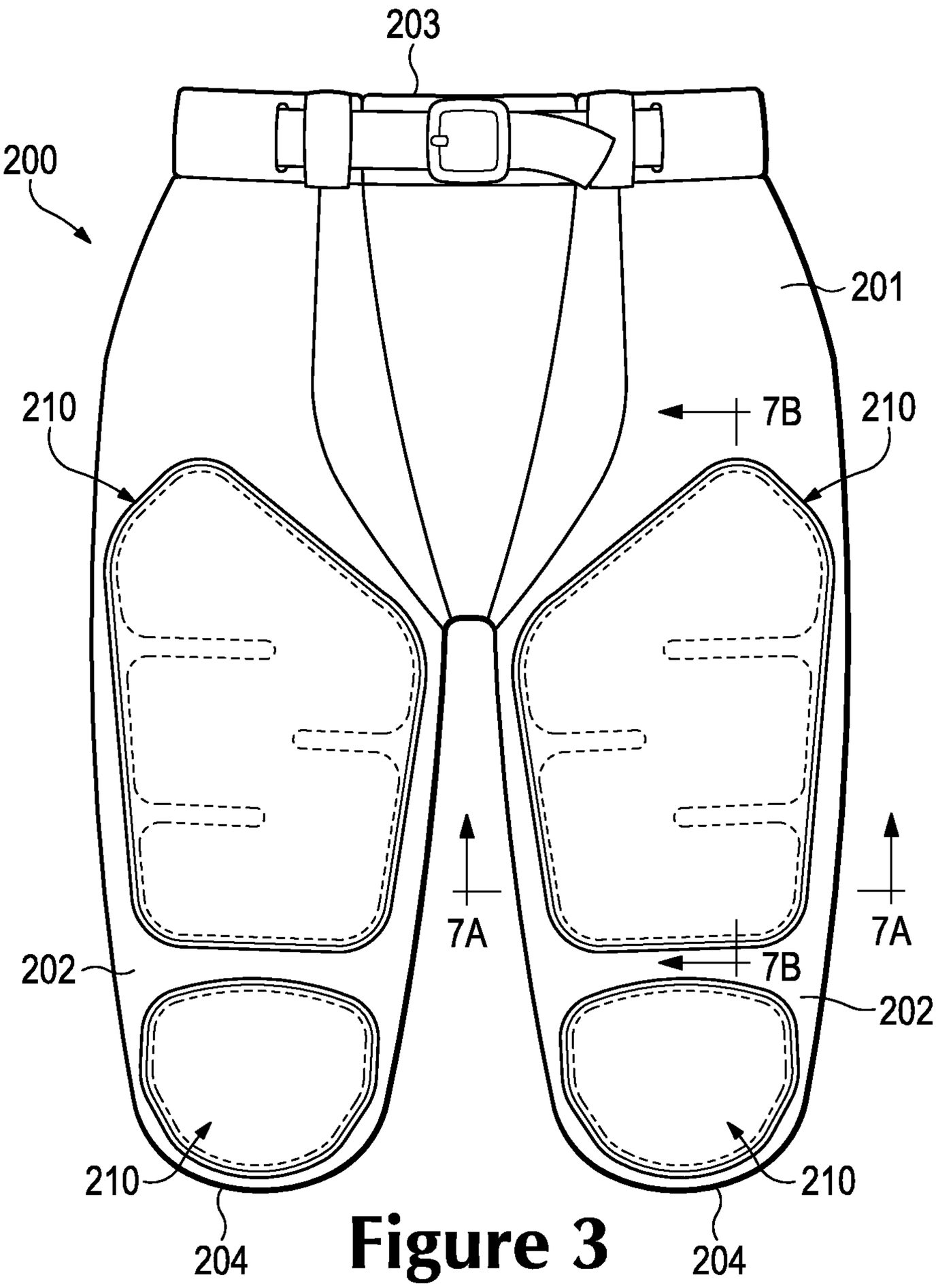

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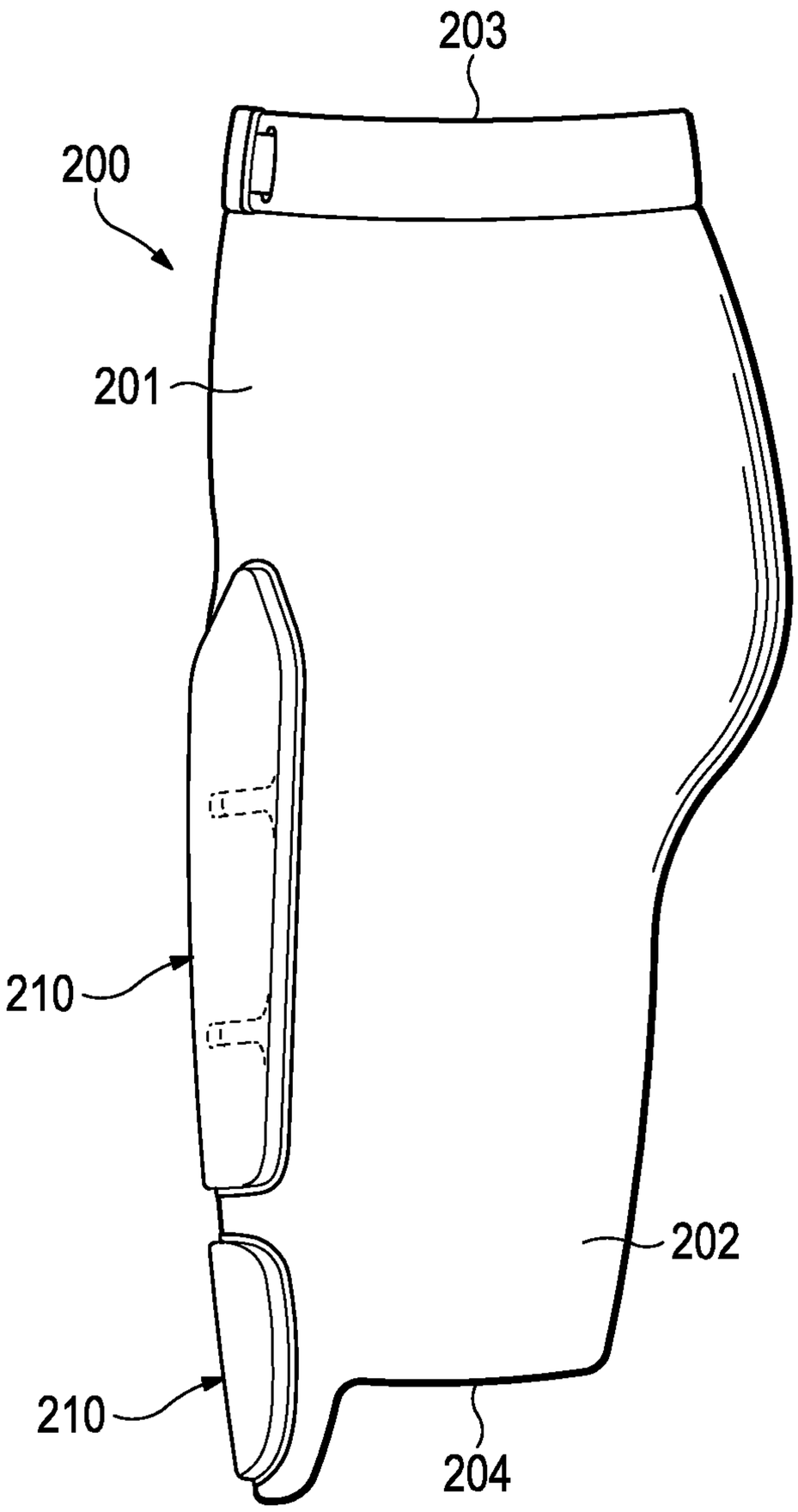

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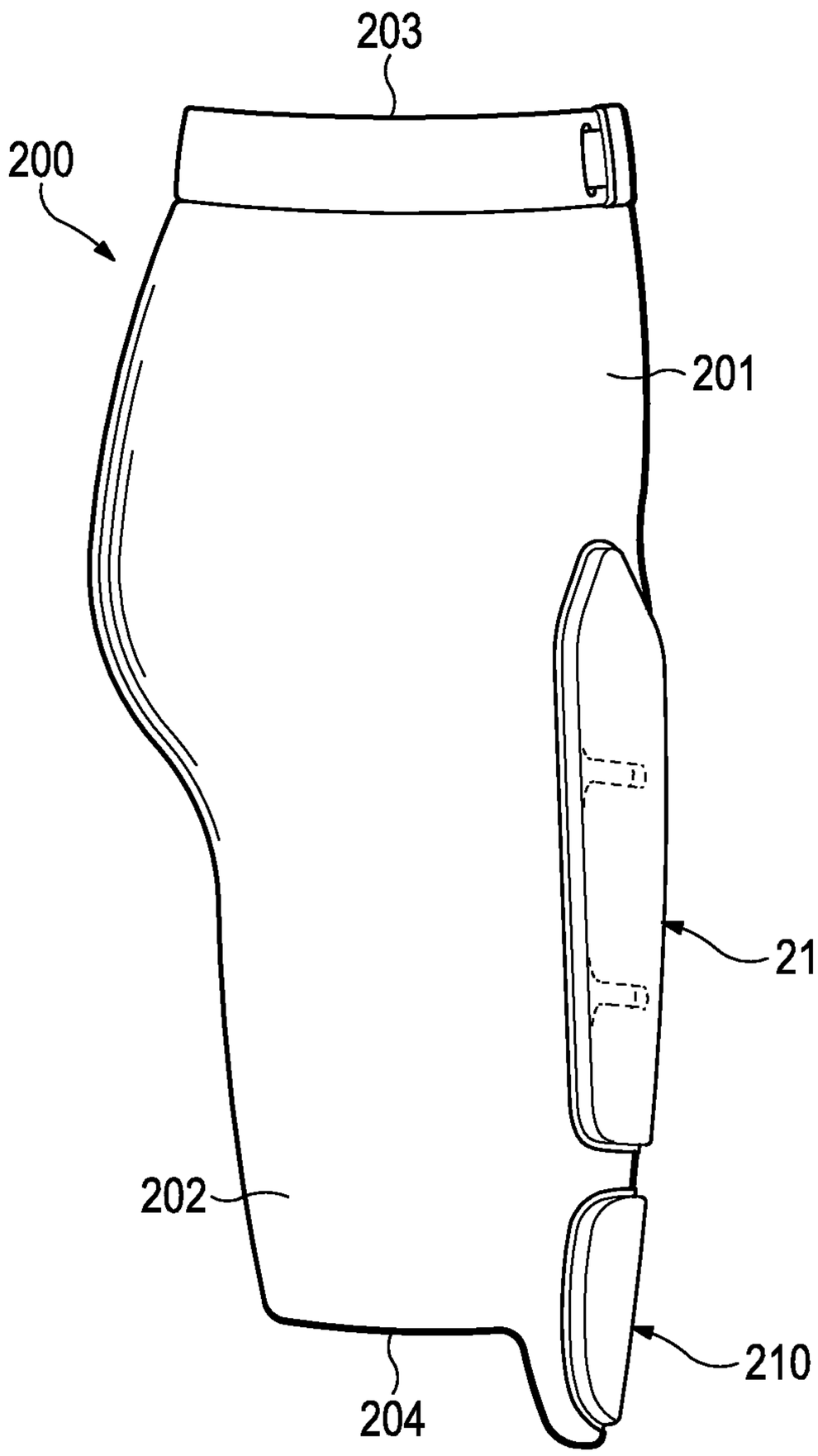

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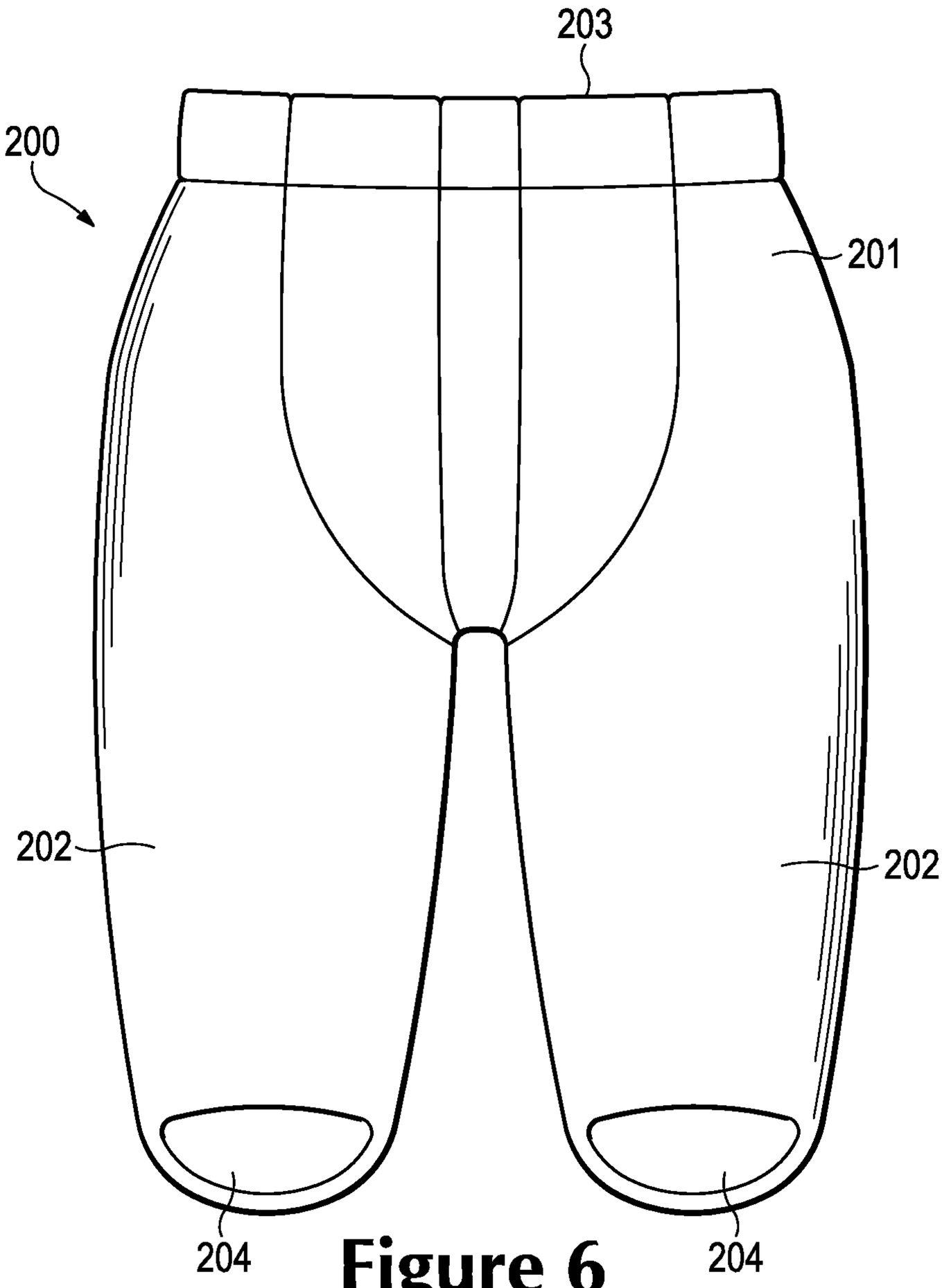

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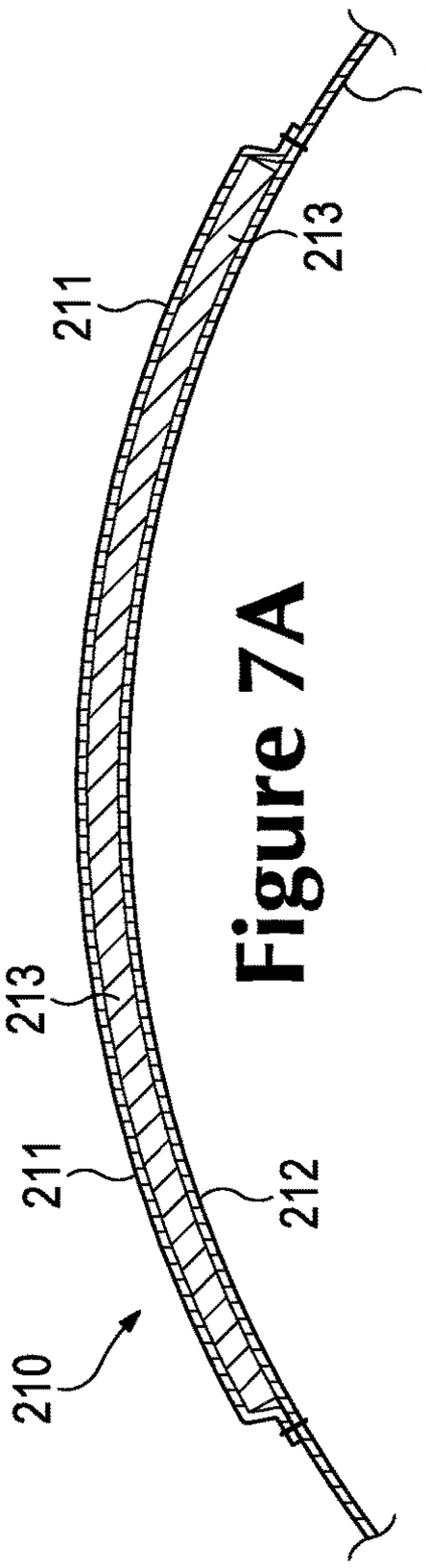

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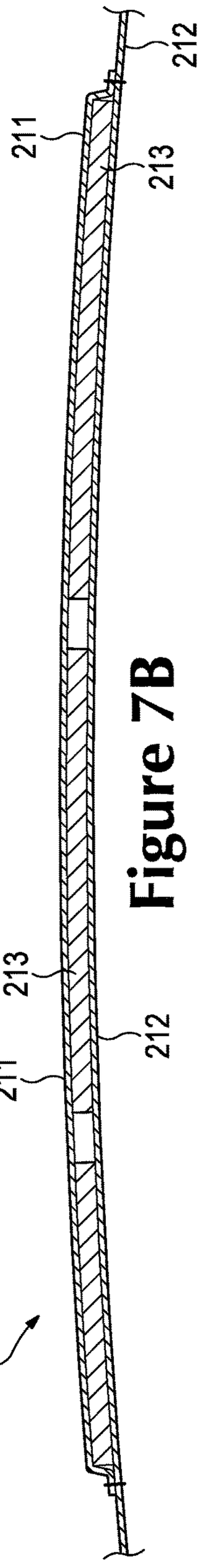
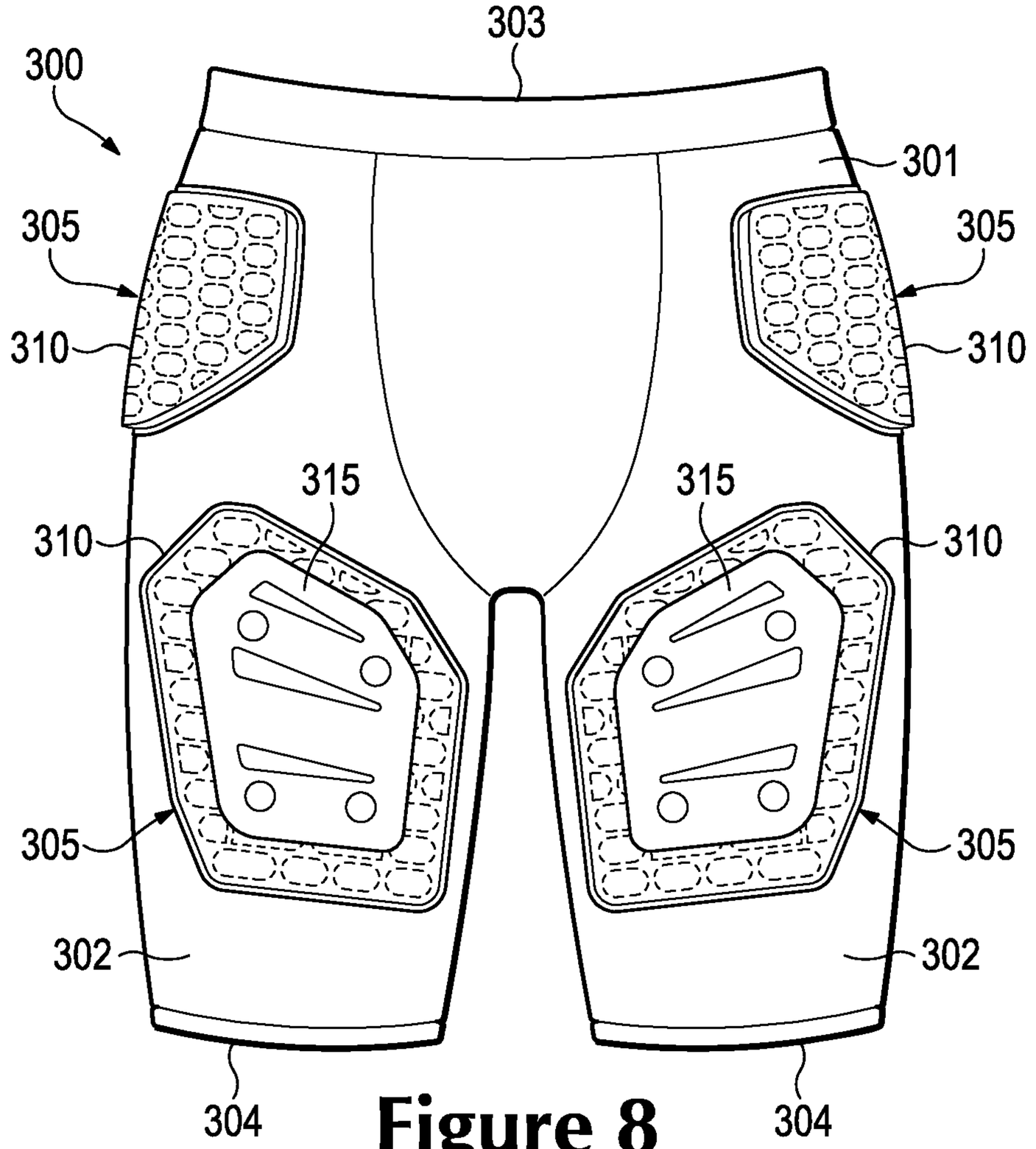


Figure 7B



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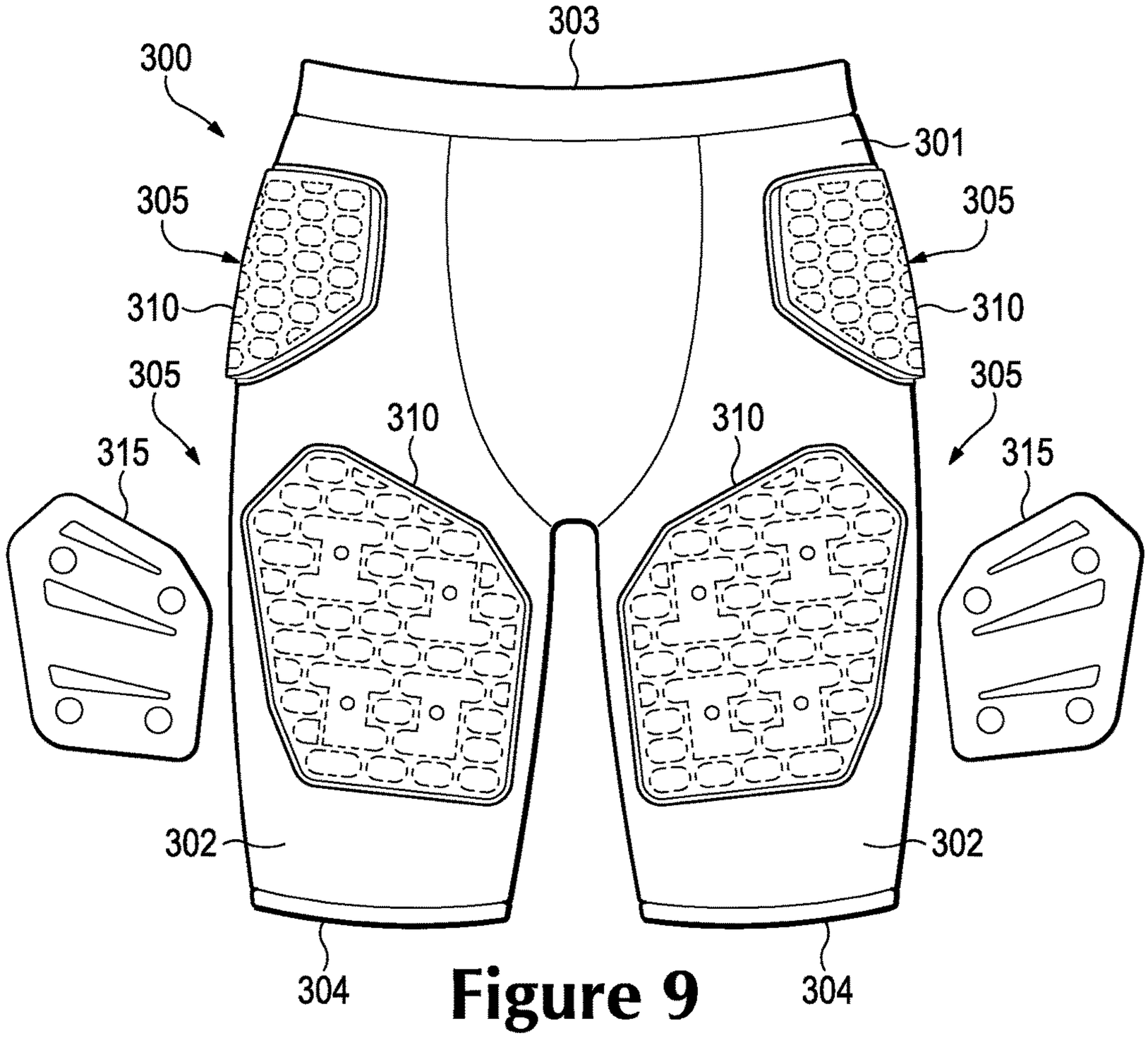

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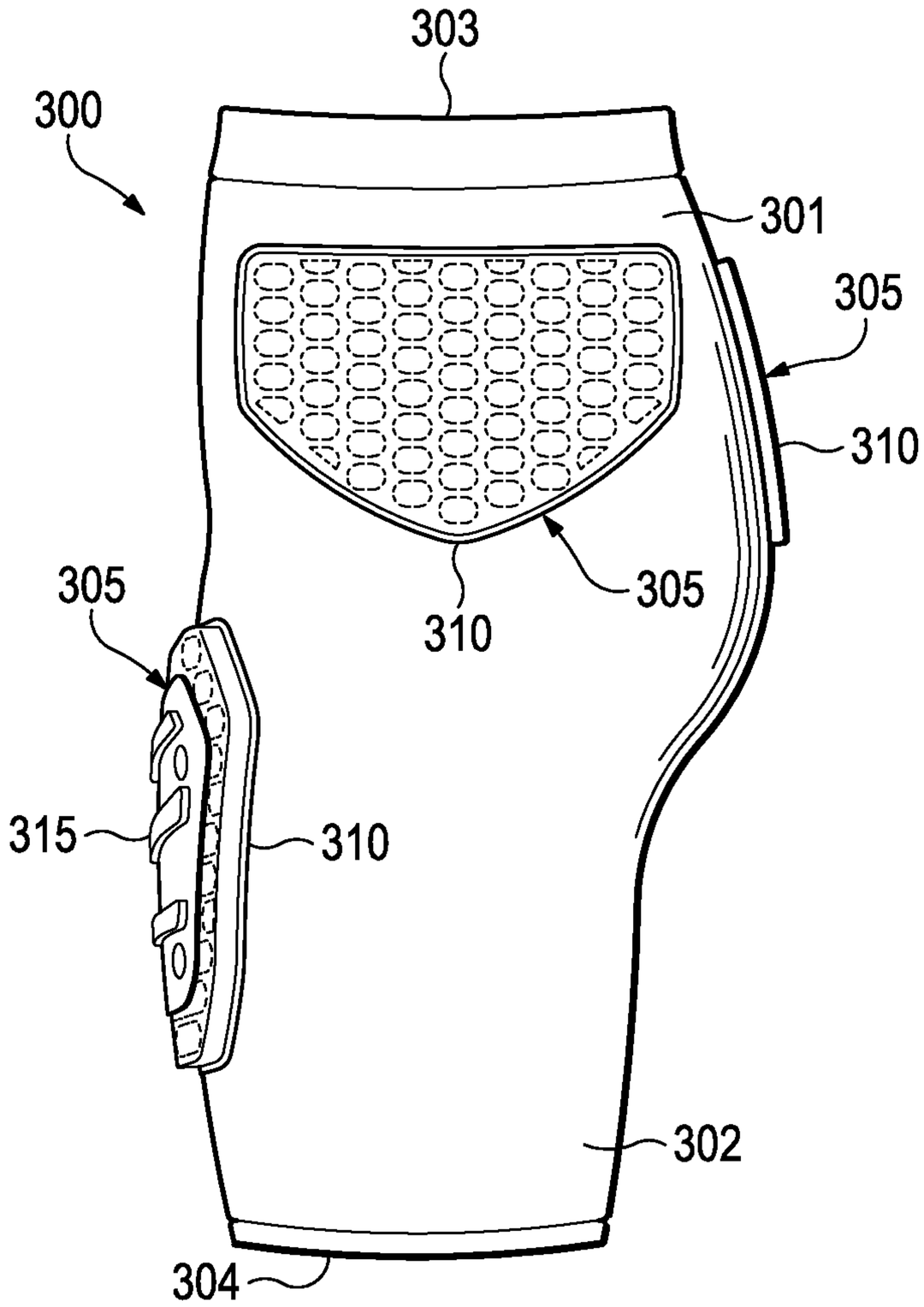

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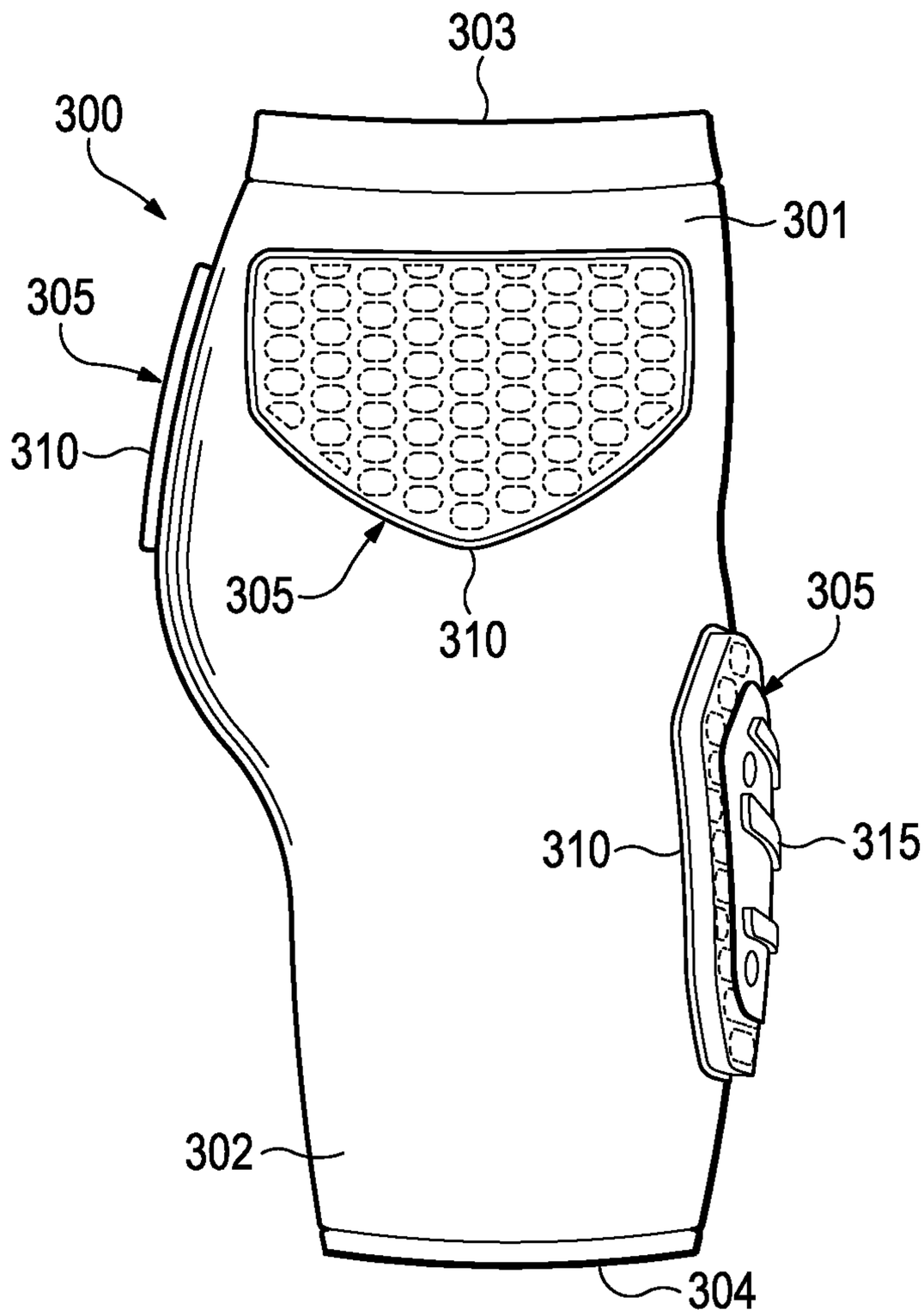

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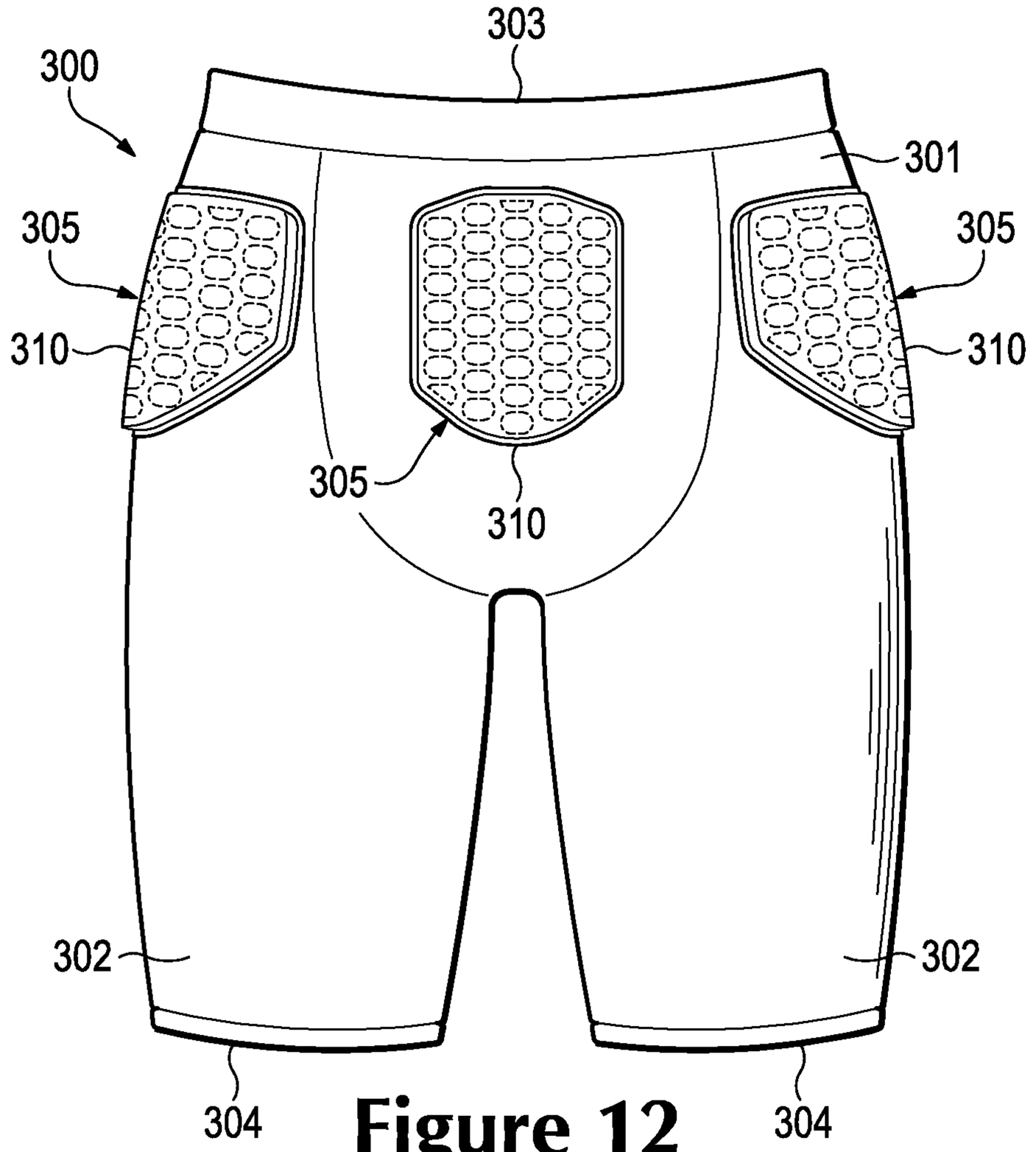

Figure 12

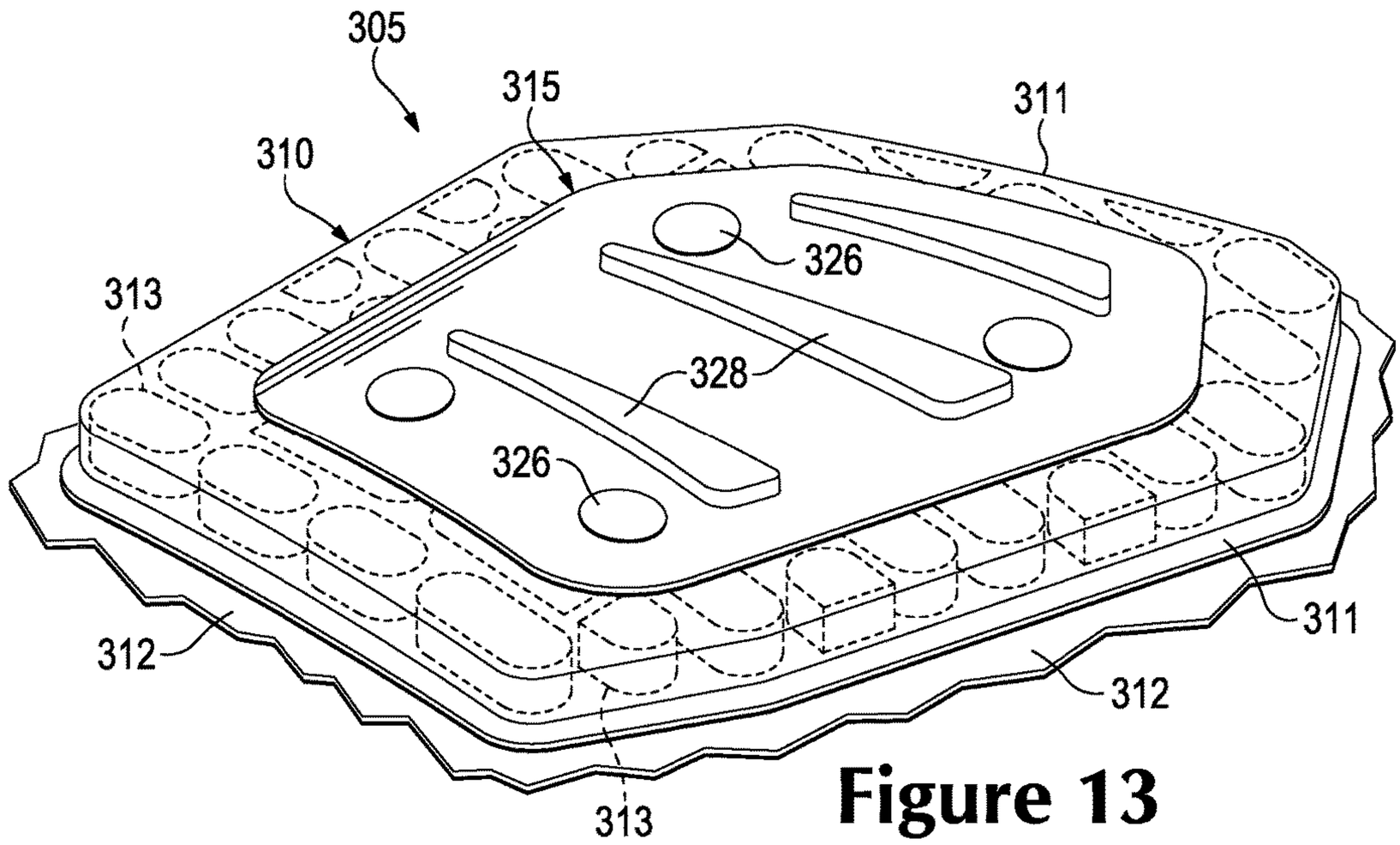

Figure 13

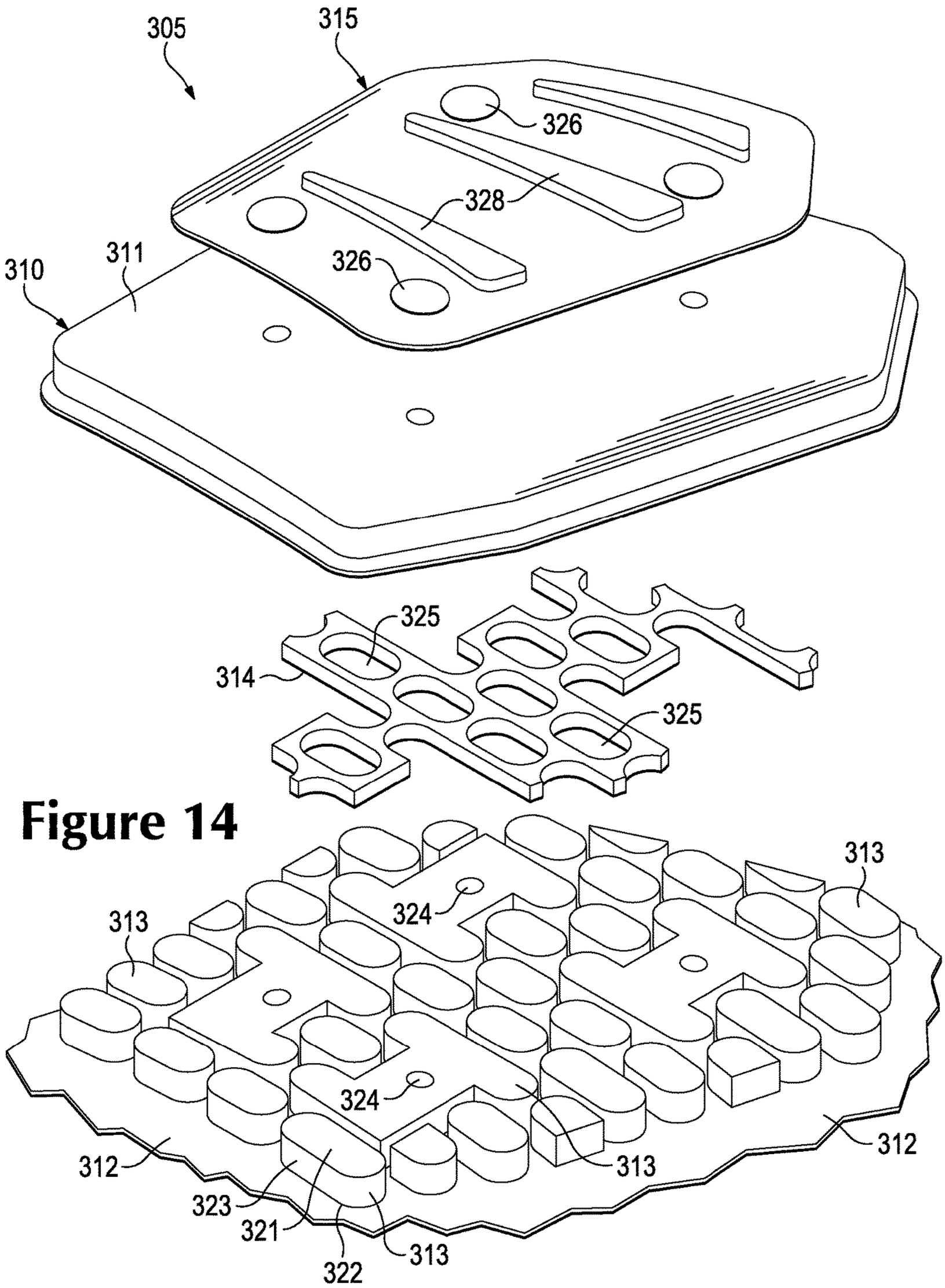
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Figure 14

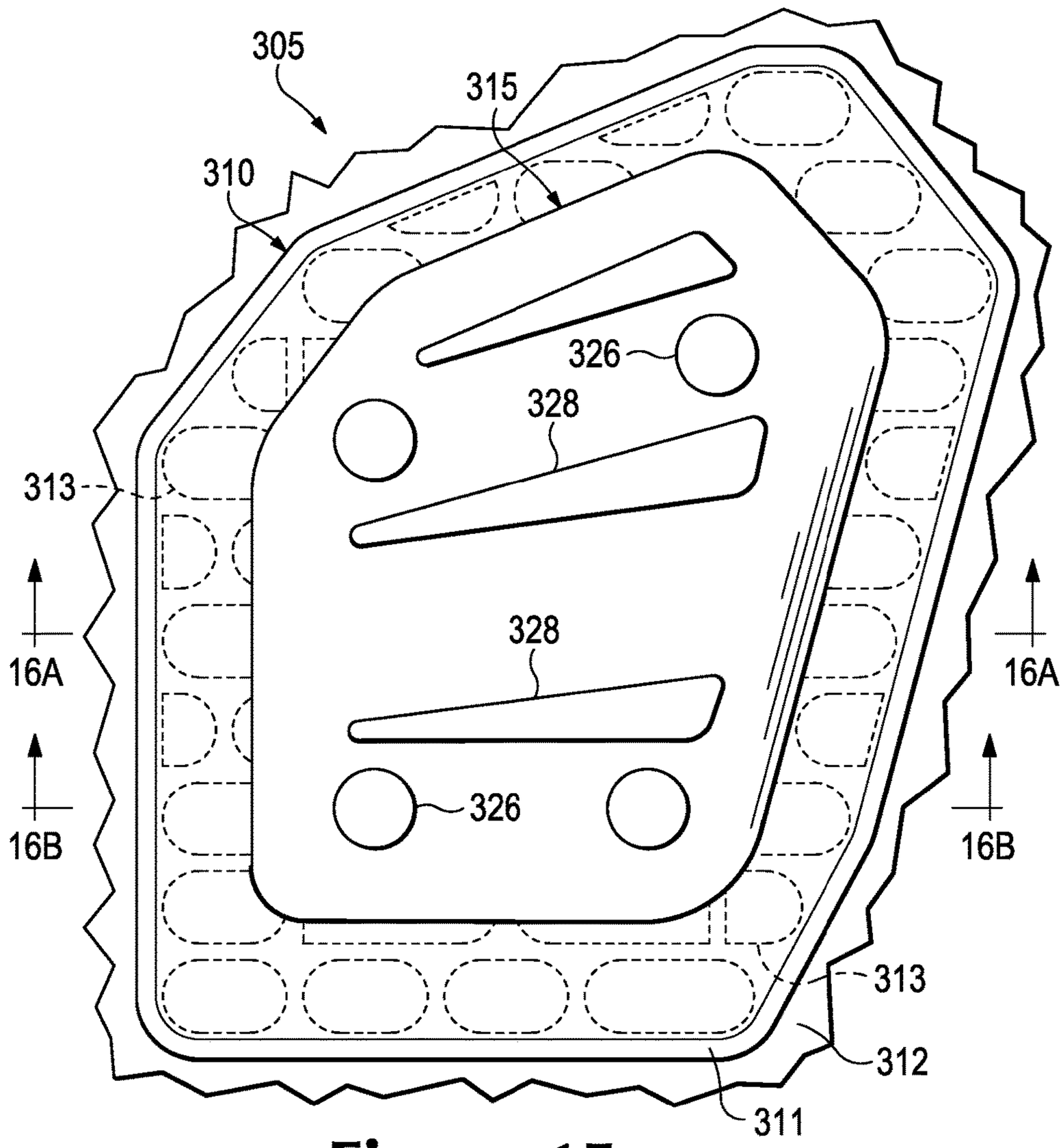


Figure 15

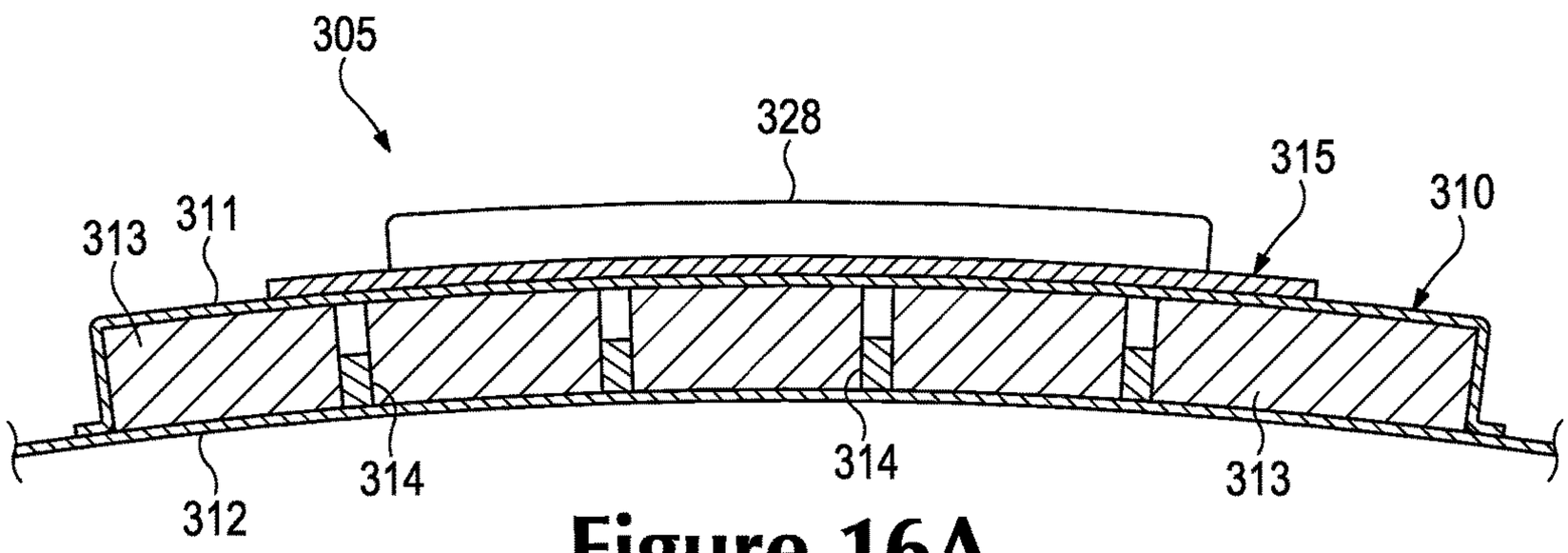


Figure 16A

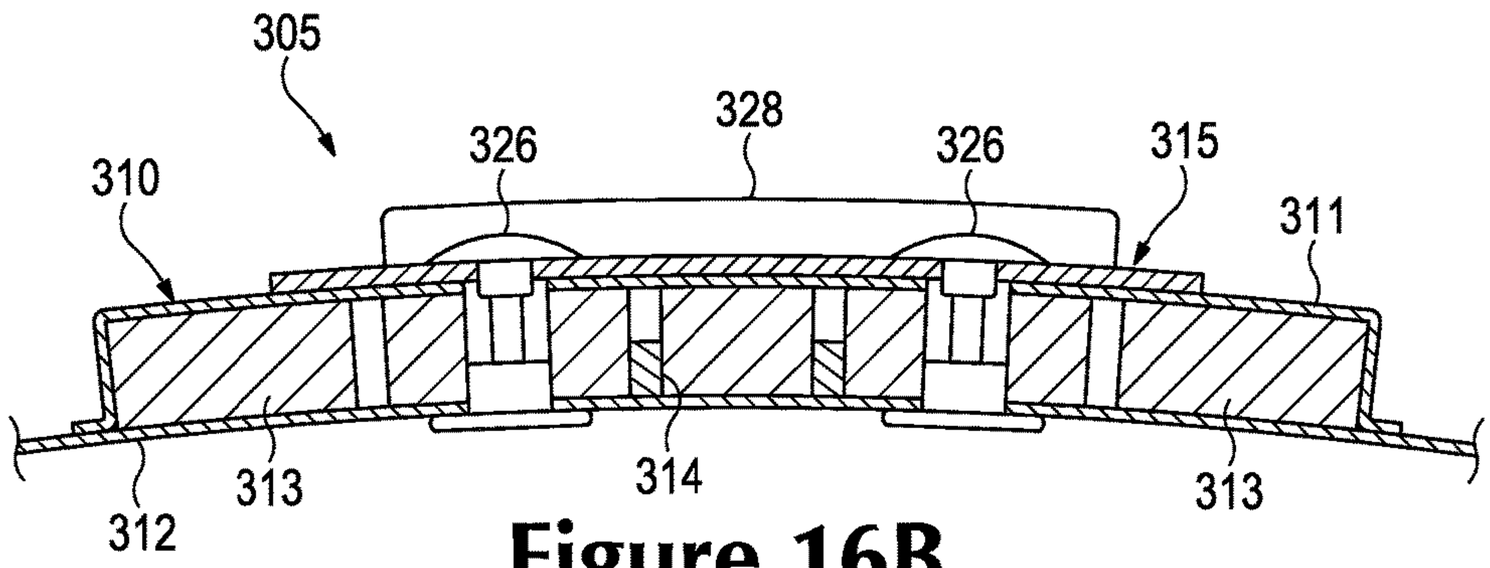


Figure 16B

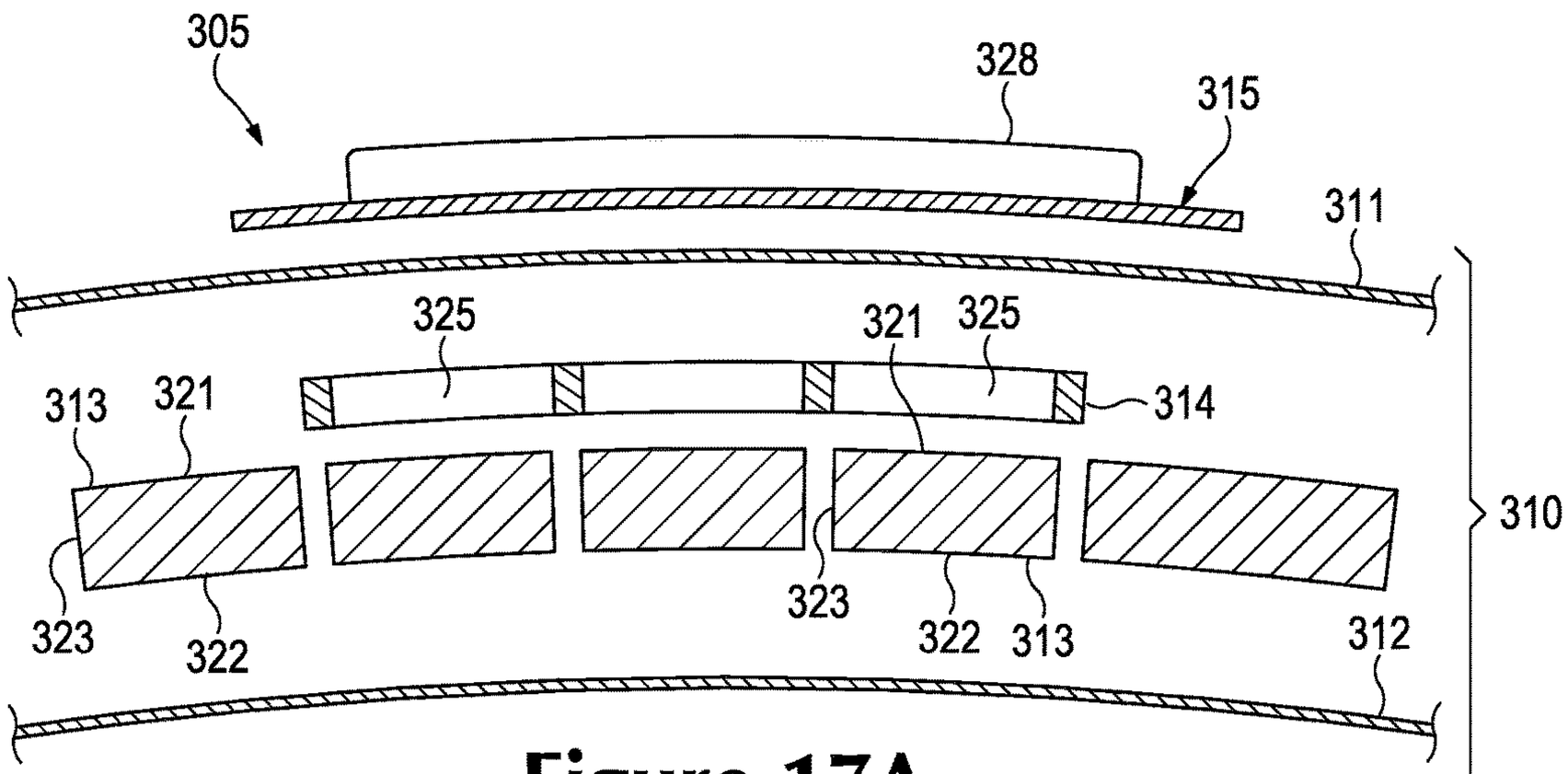


Figure 17A

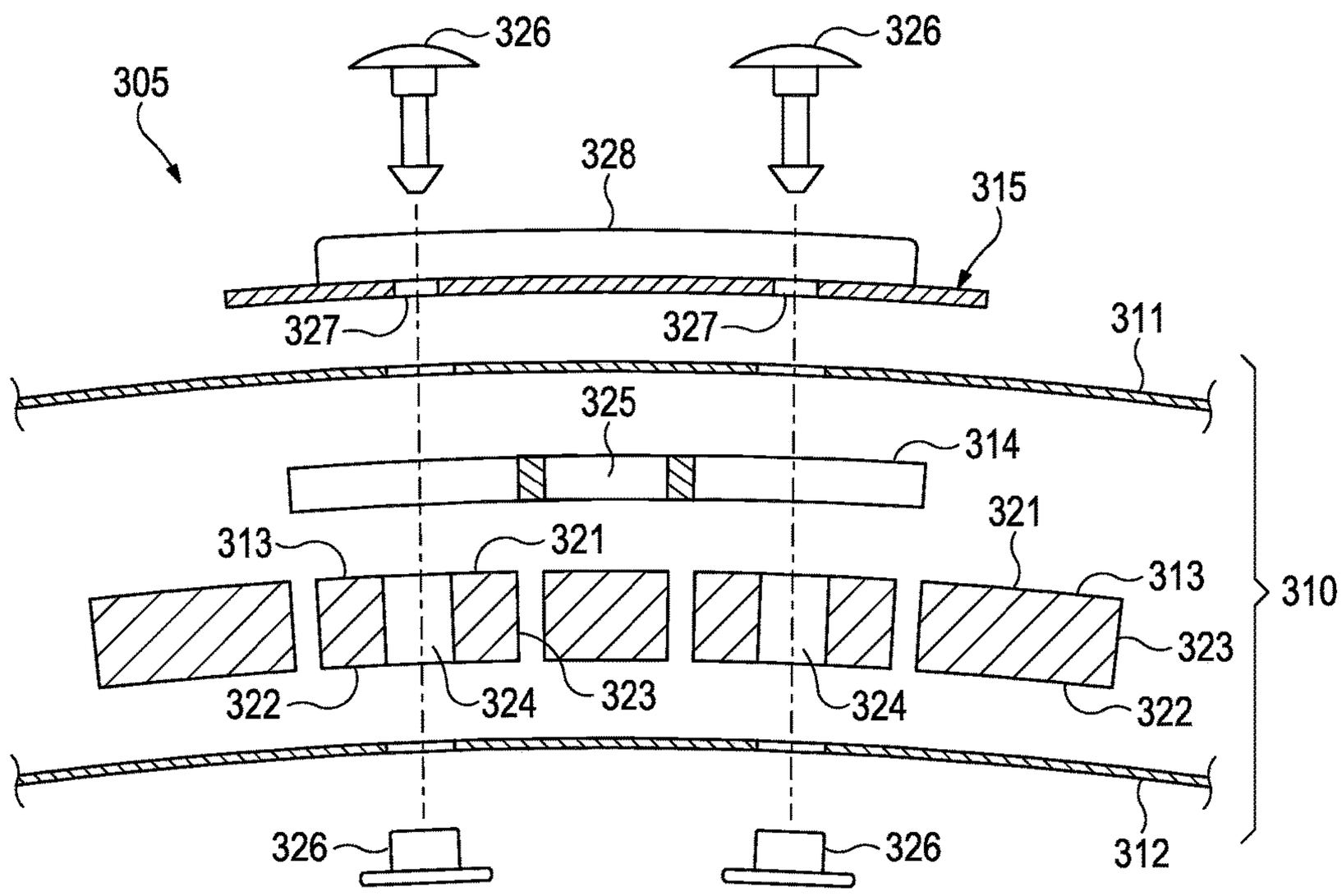


Figure 17B

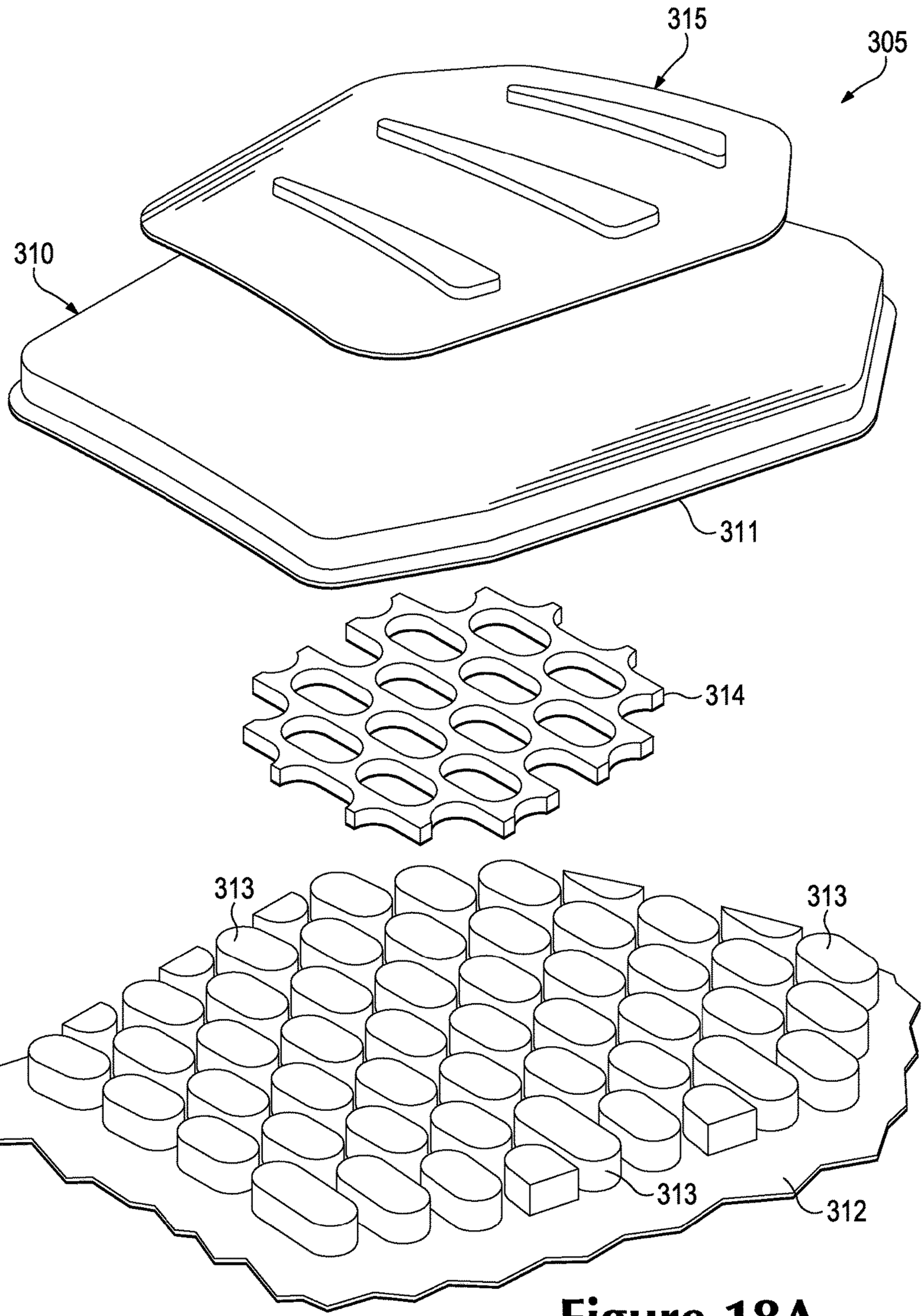


Figure 18A

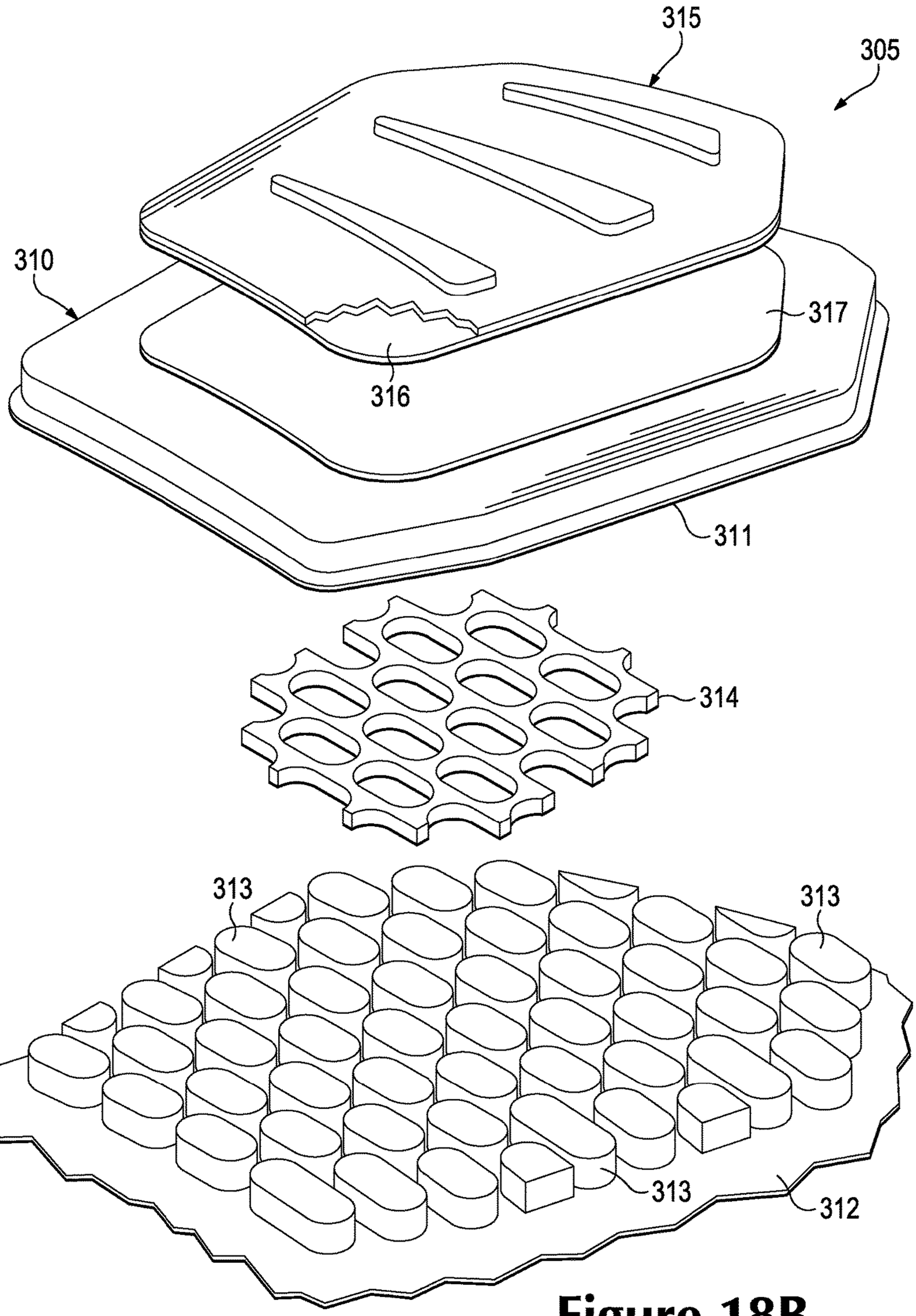


Figure 18B

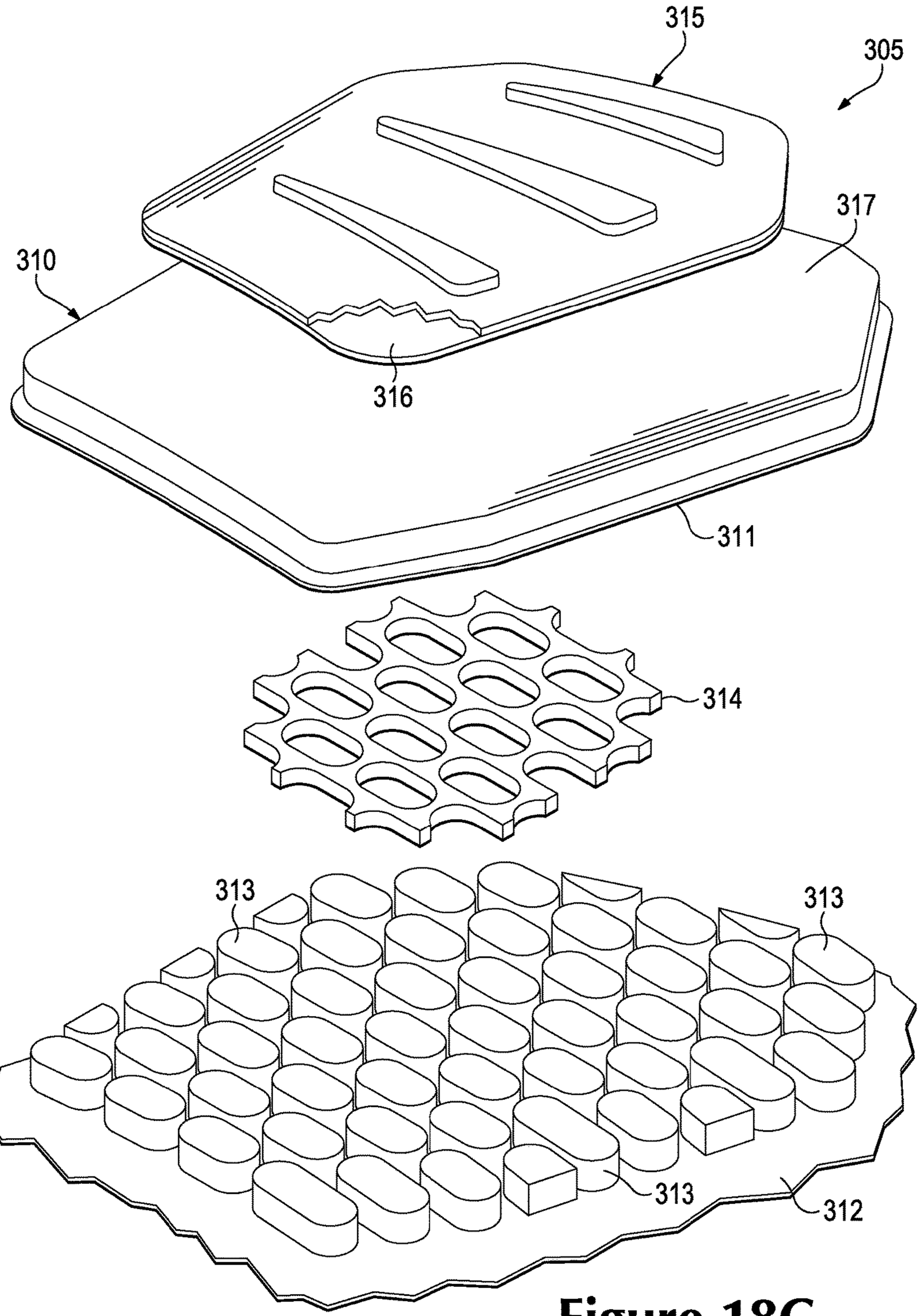


Figure 18C

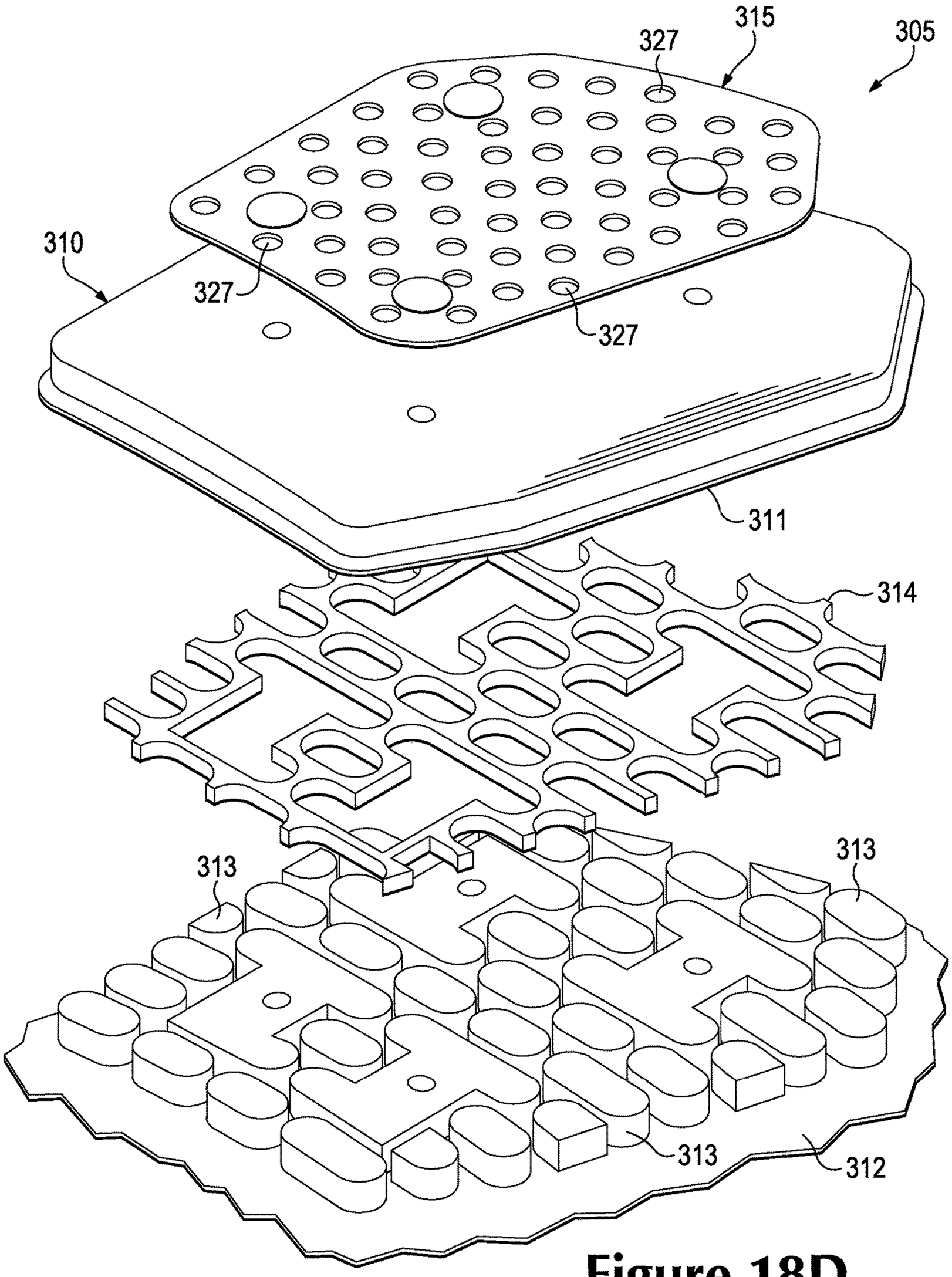


Figure 18D

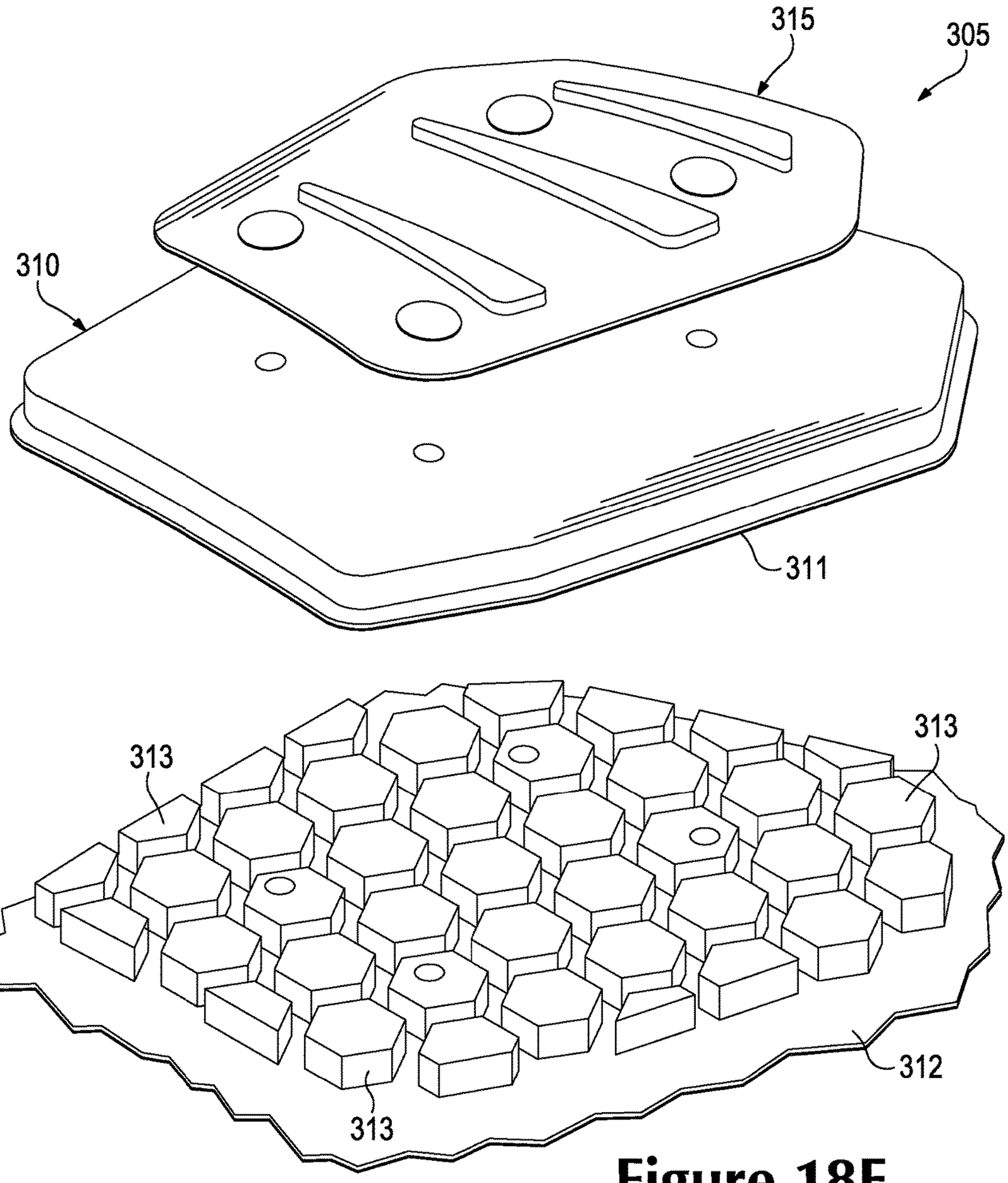


Figure 18E

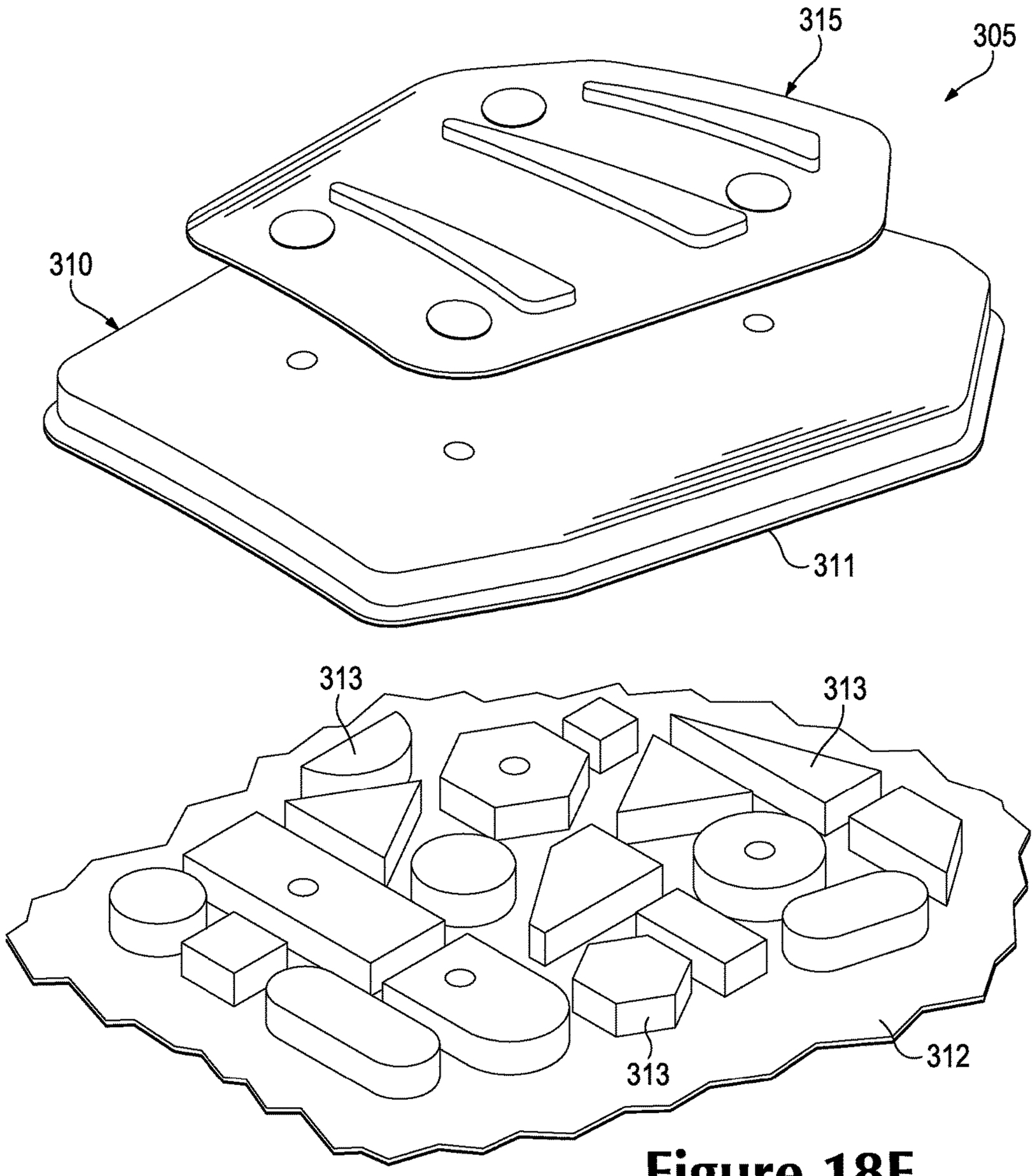


Figure 18F

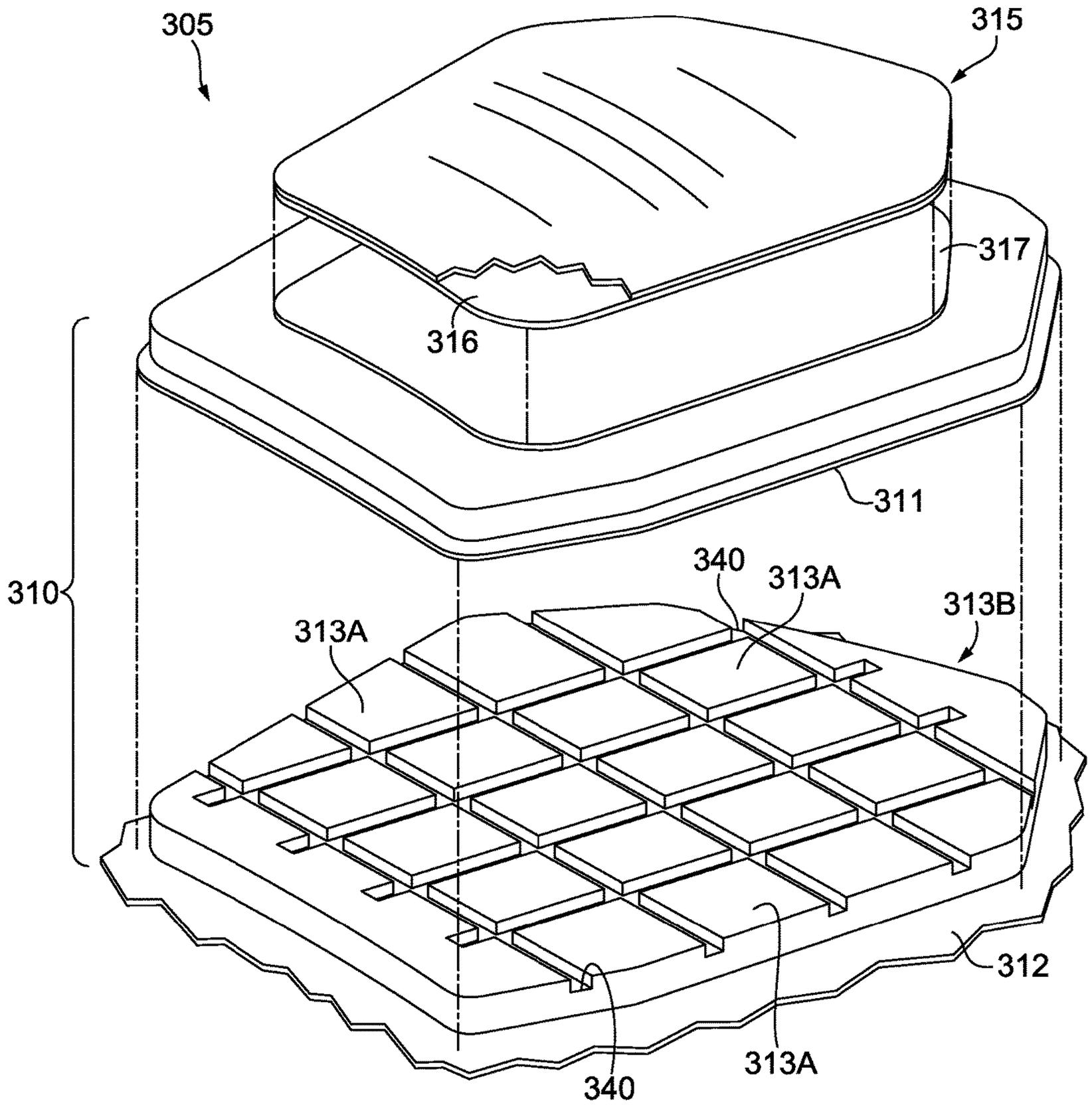


FIG. 18G

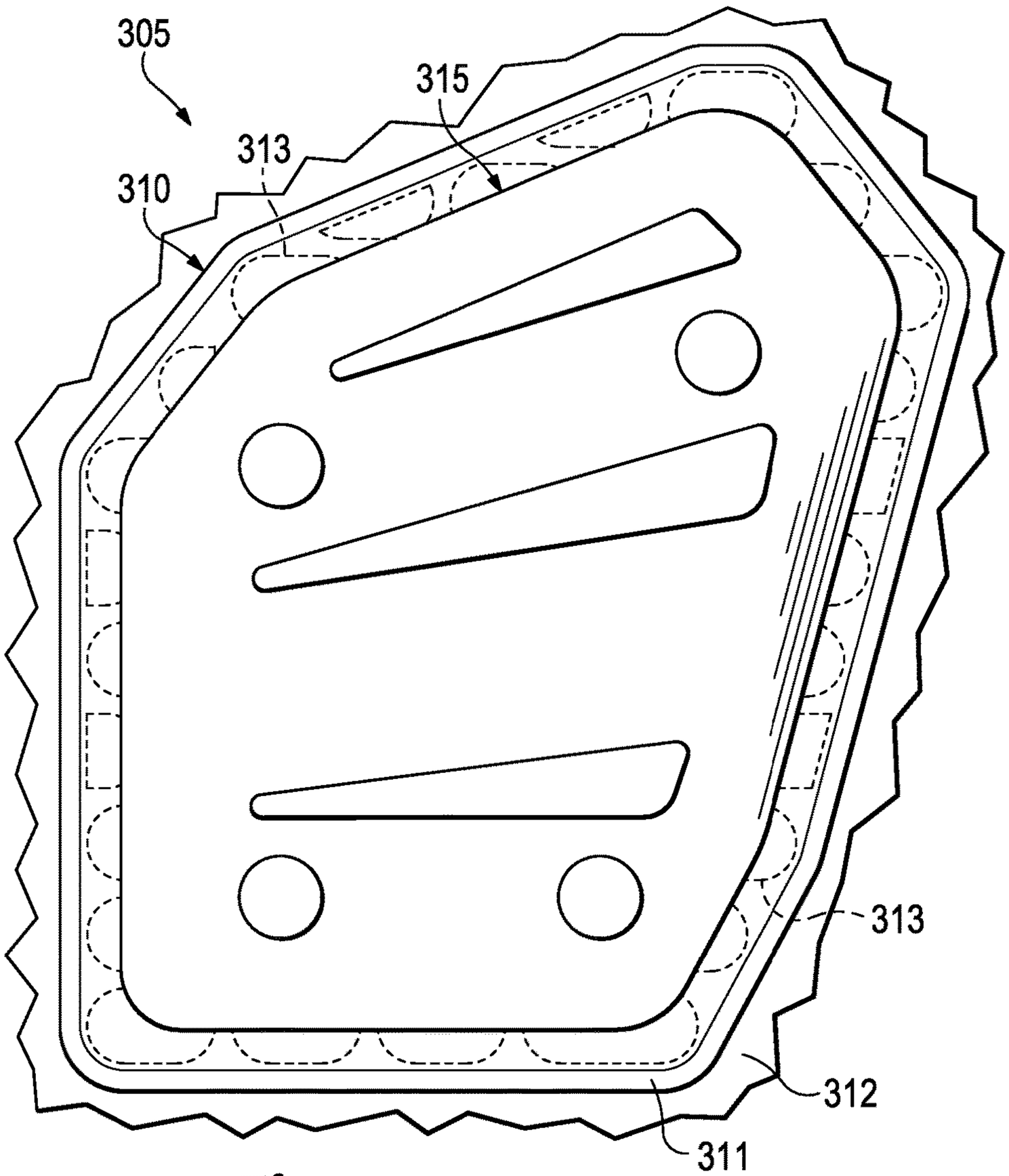


Figure 19A

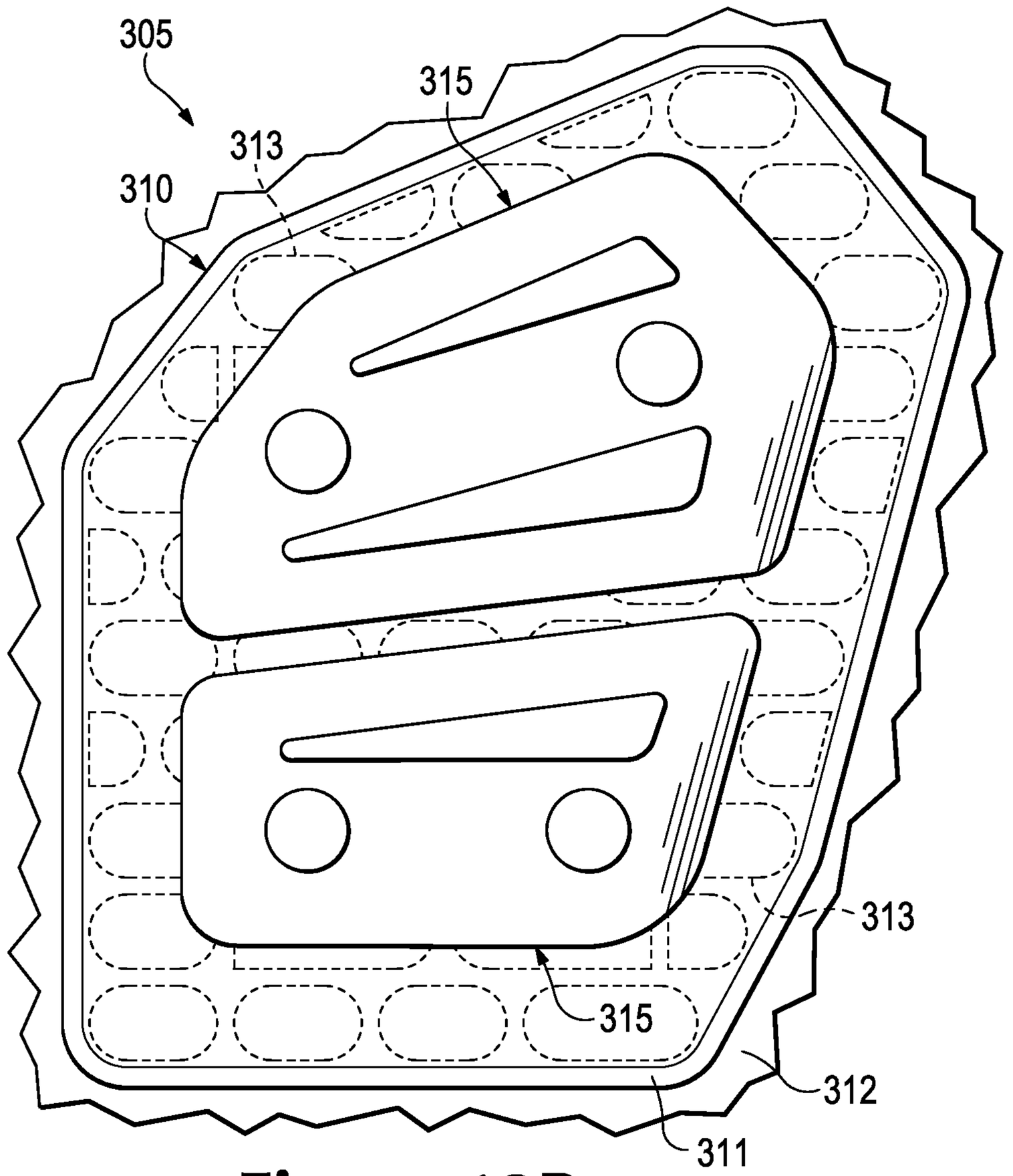


Figure 19B

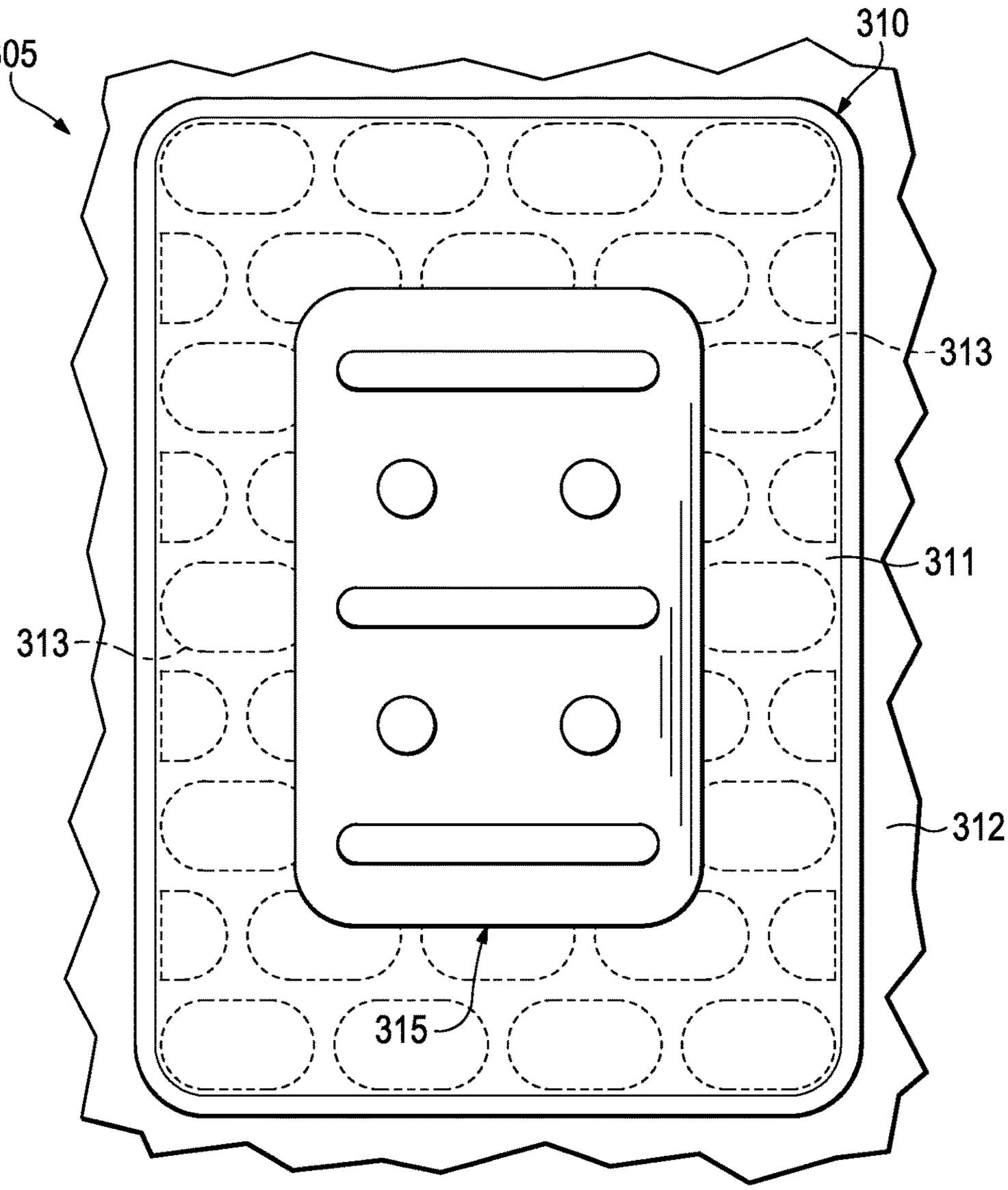


Figure 19C

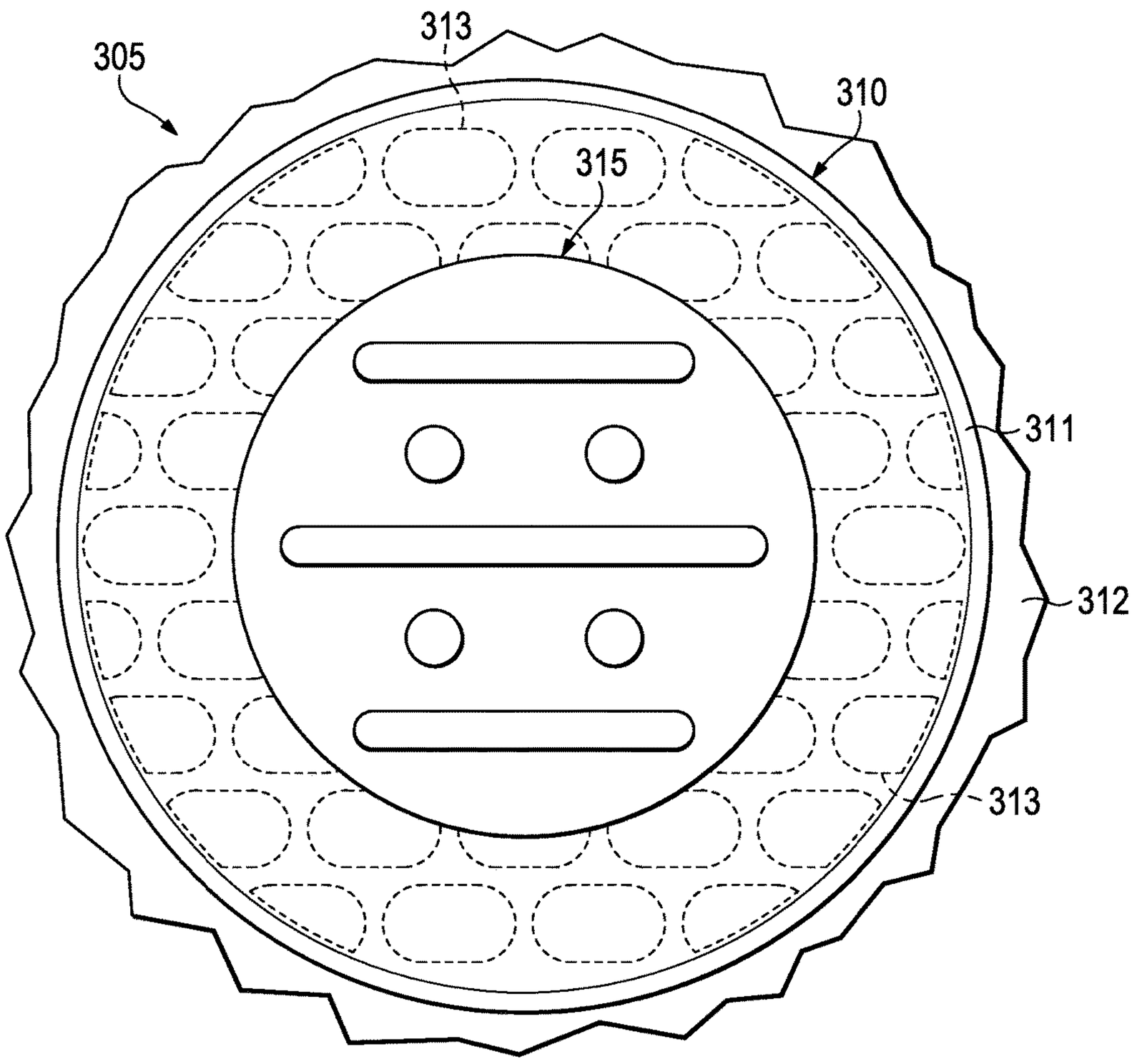


Figure 19D

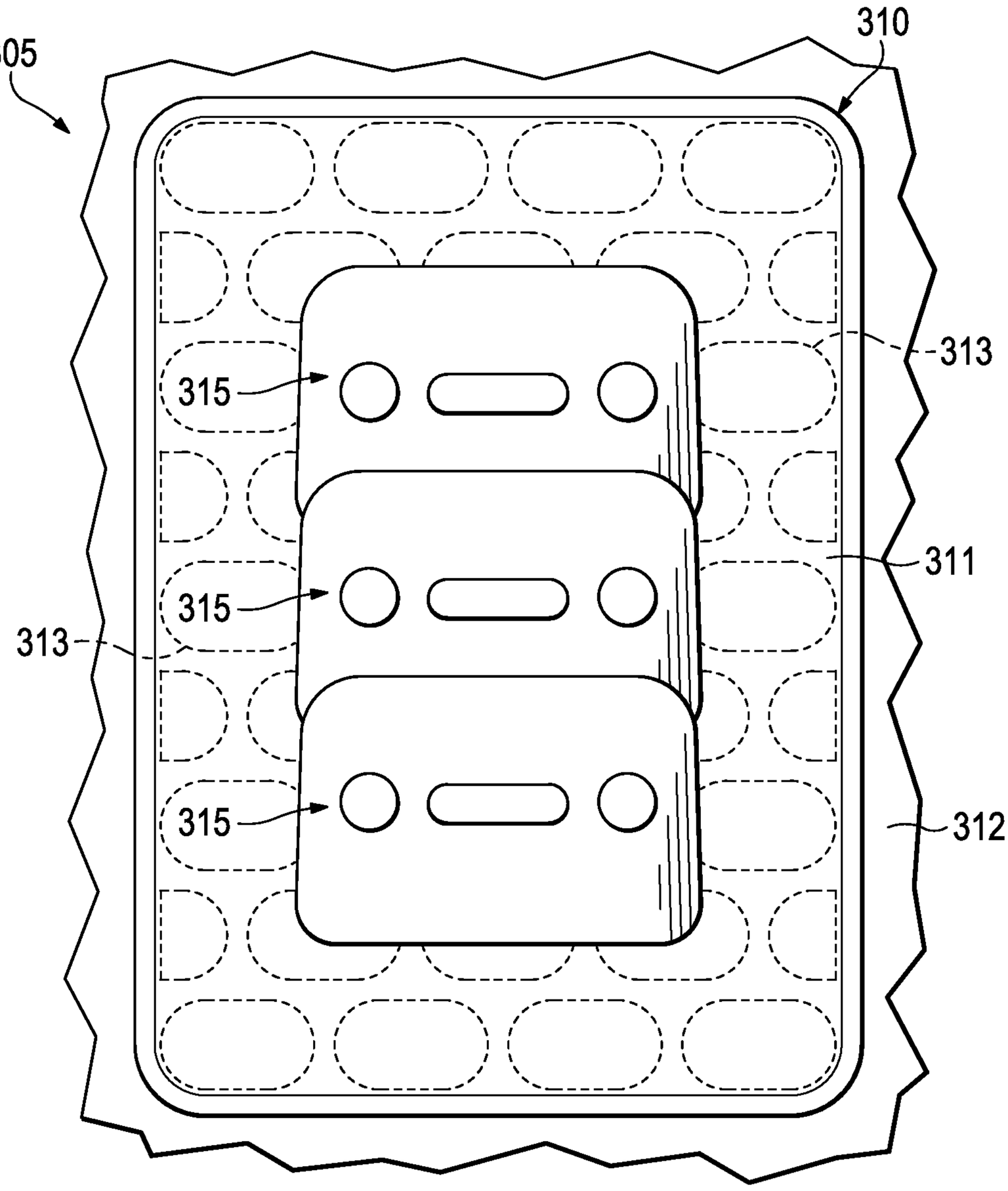


Figure 19E

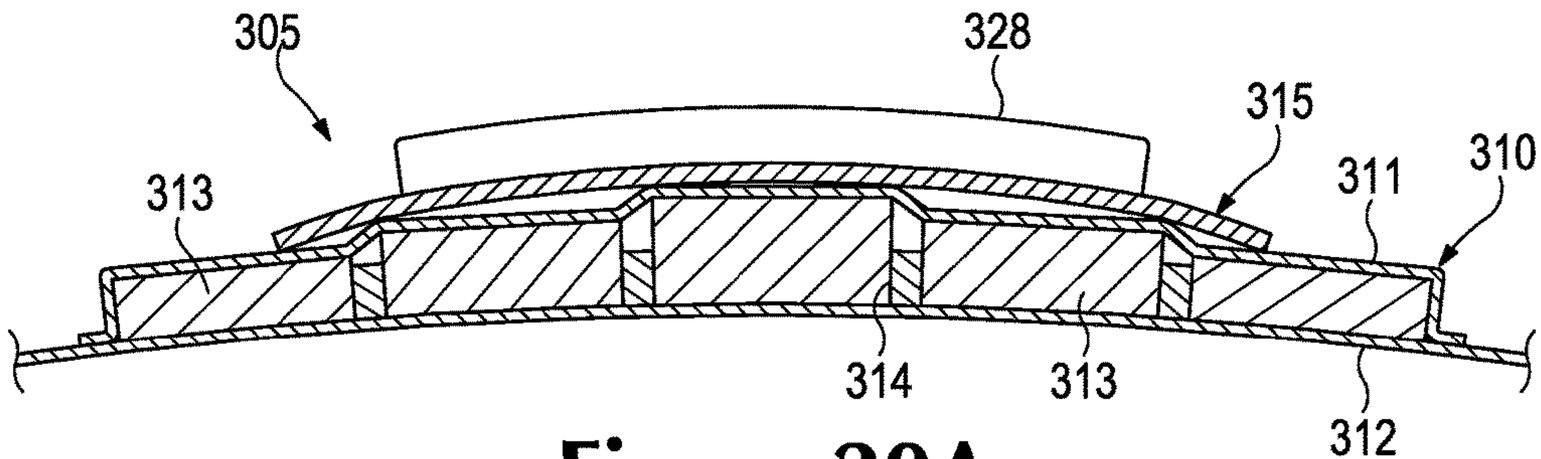


Figure 20A

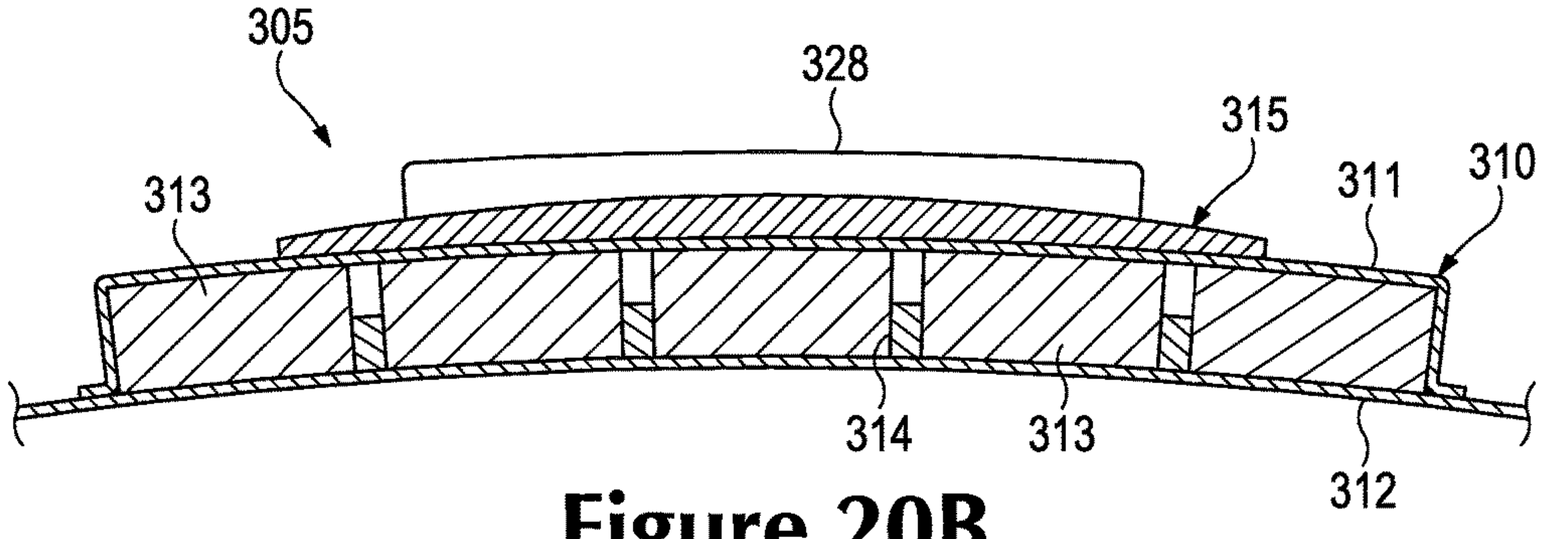


Figure 20B

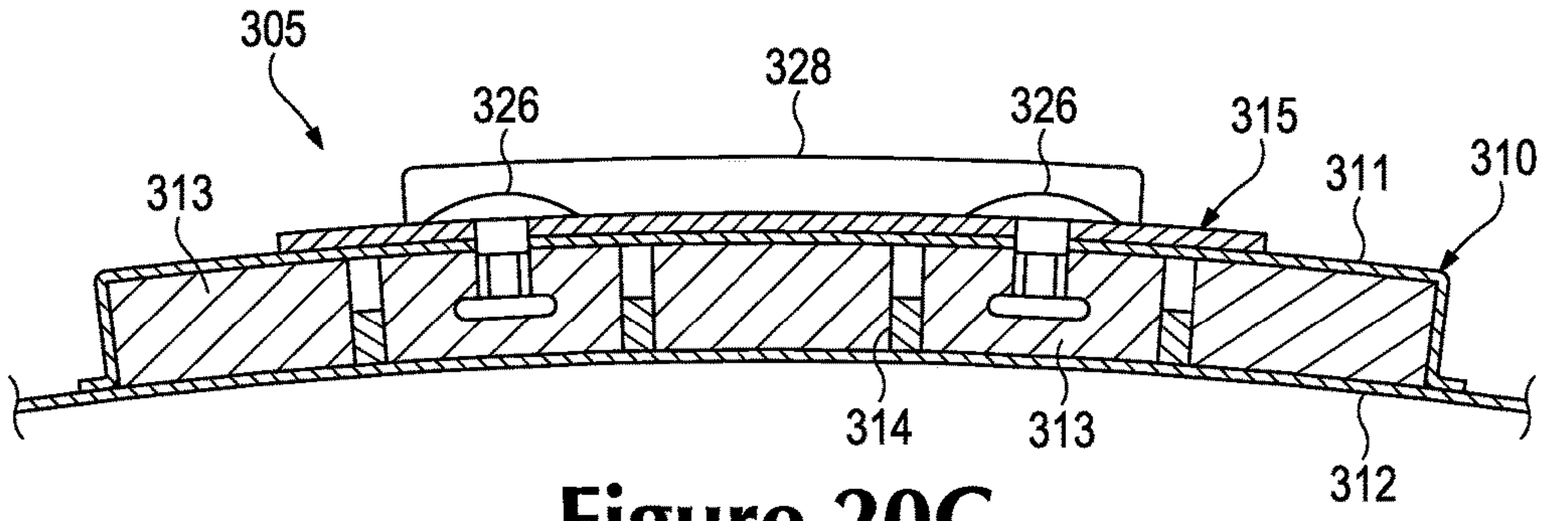


Figure 20C

Figure 21

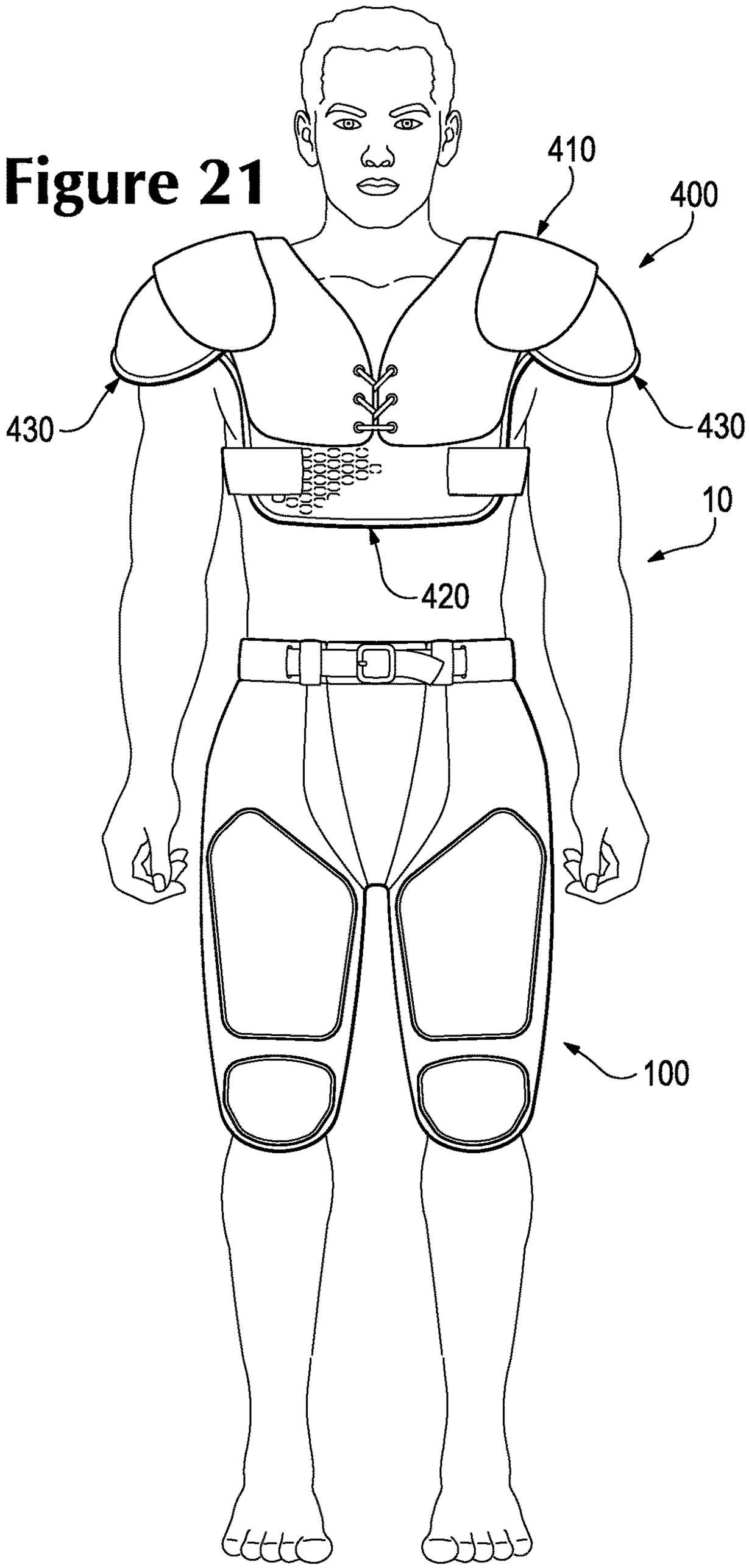
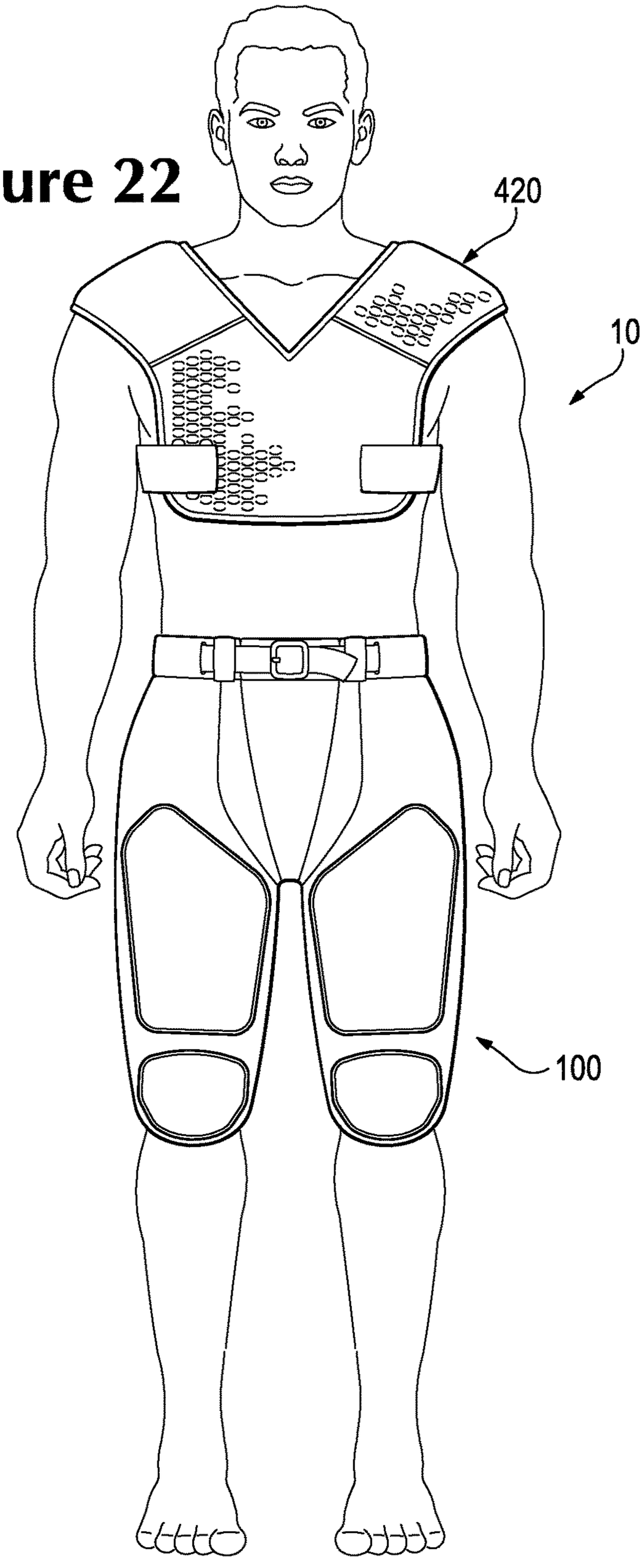


Figure 22



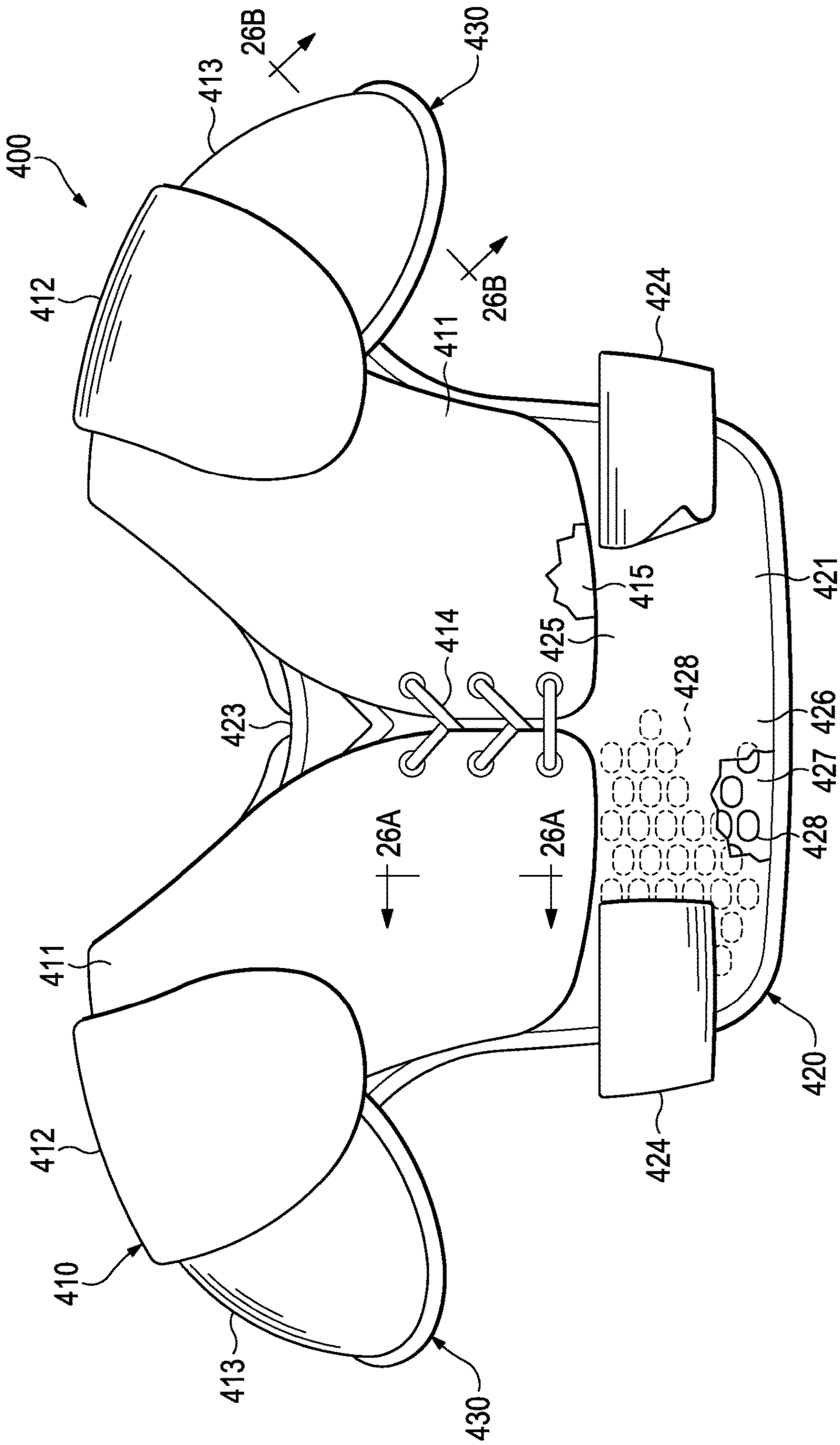

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Figure 23

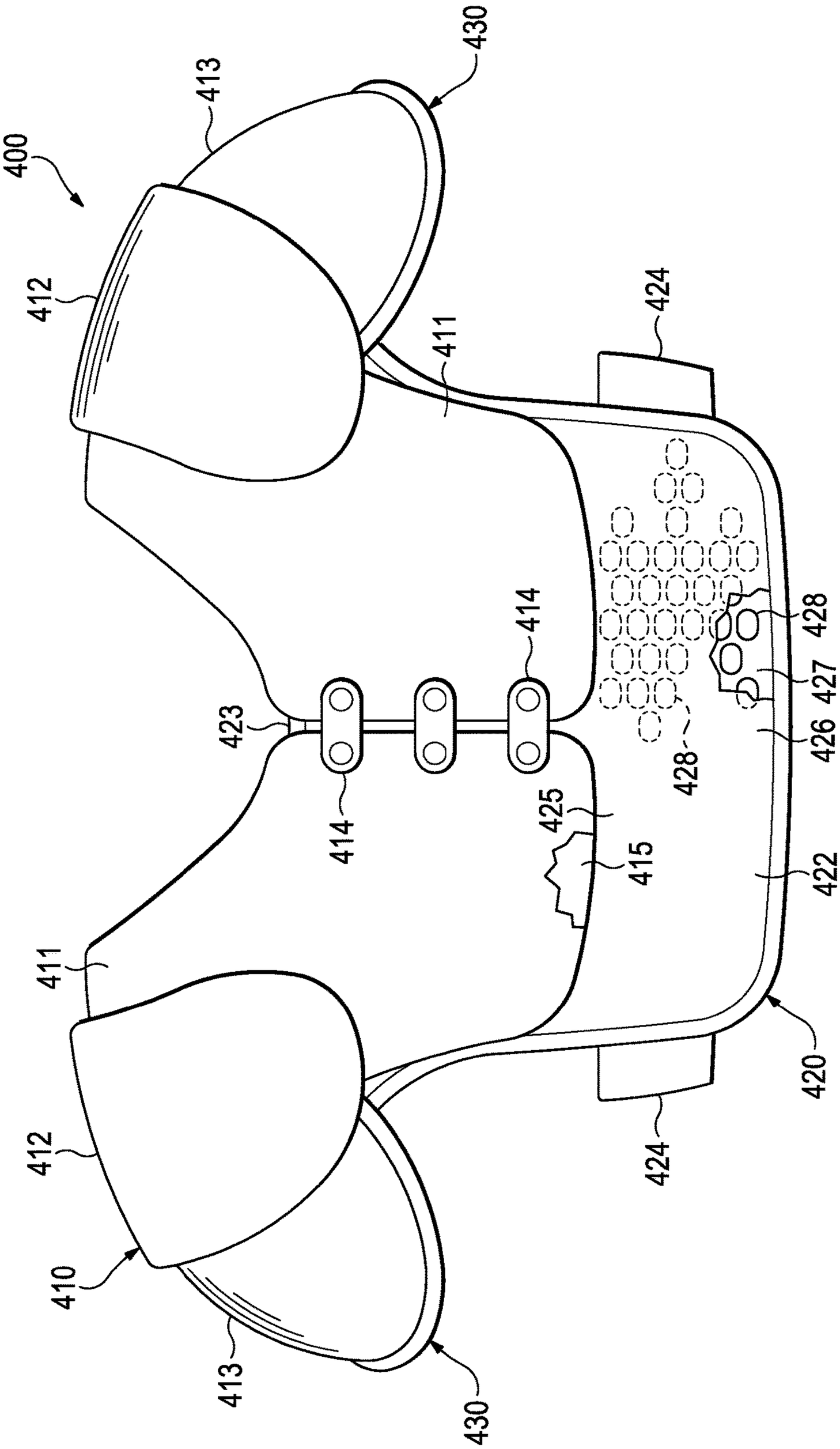
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Figure 24

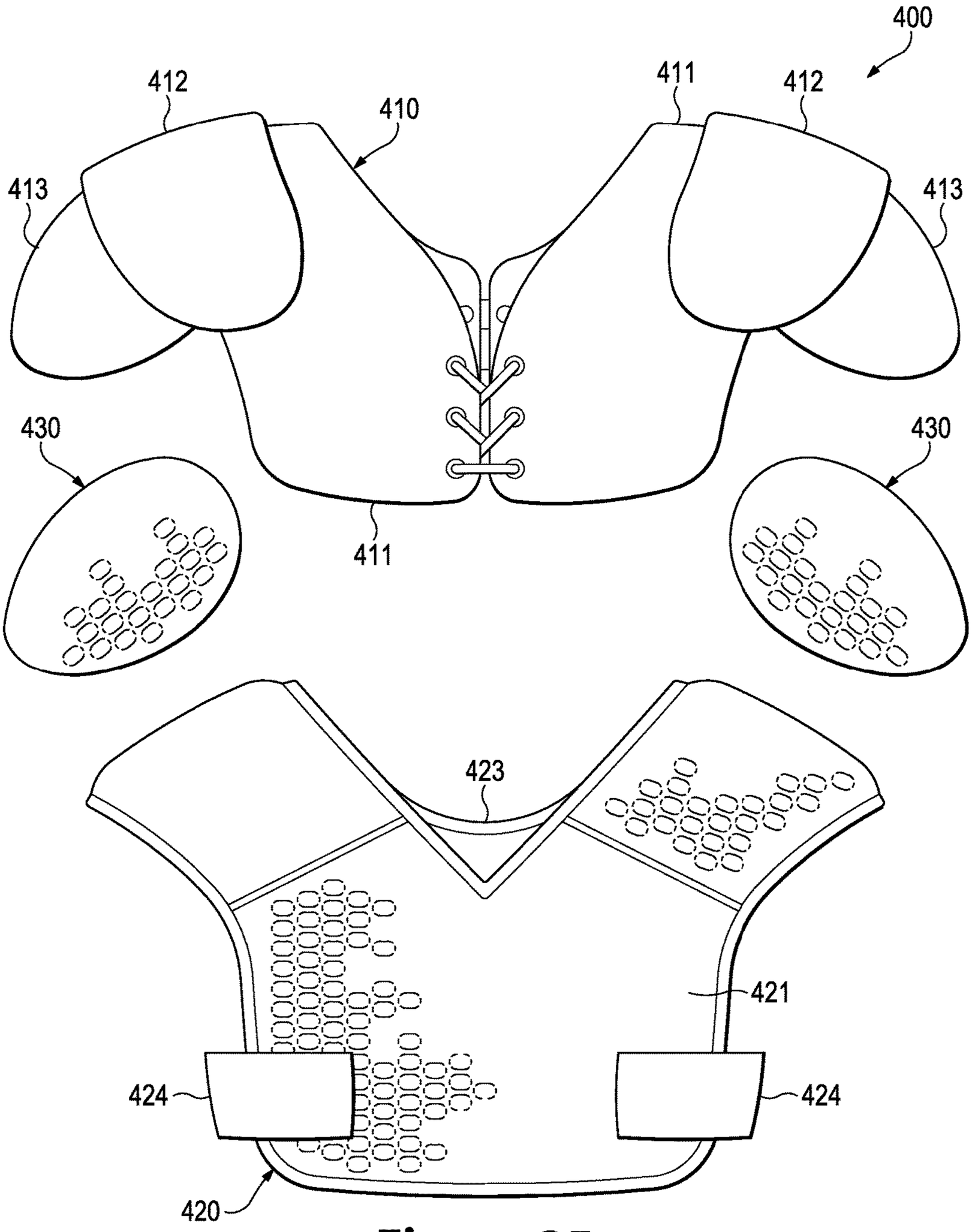


Figure 25

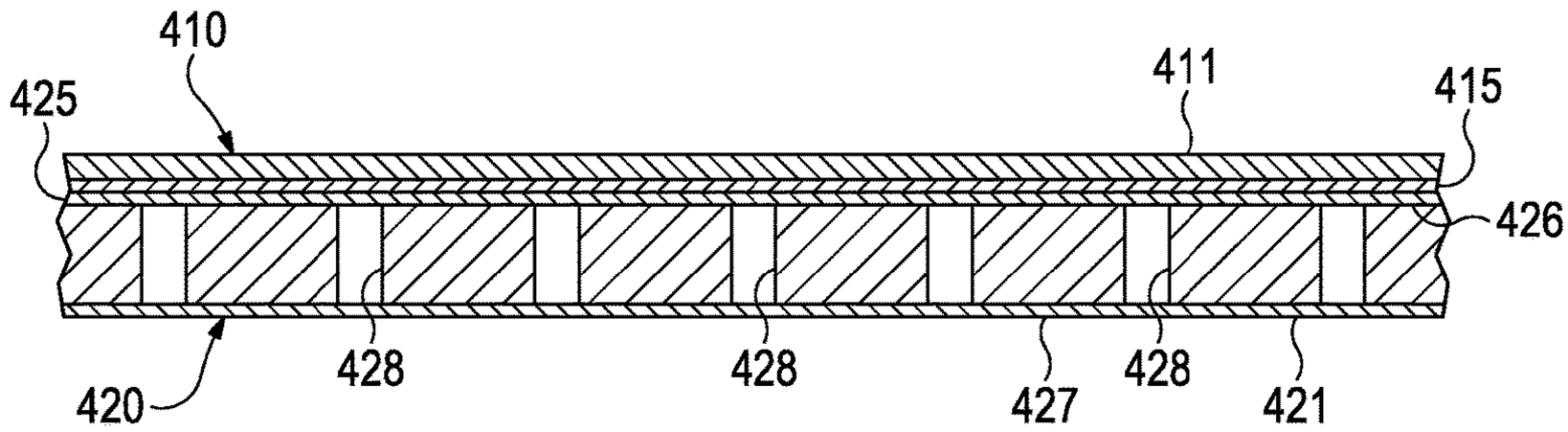


Figure 26A

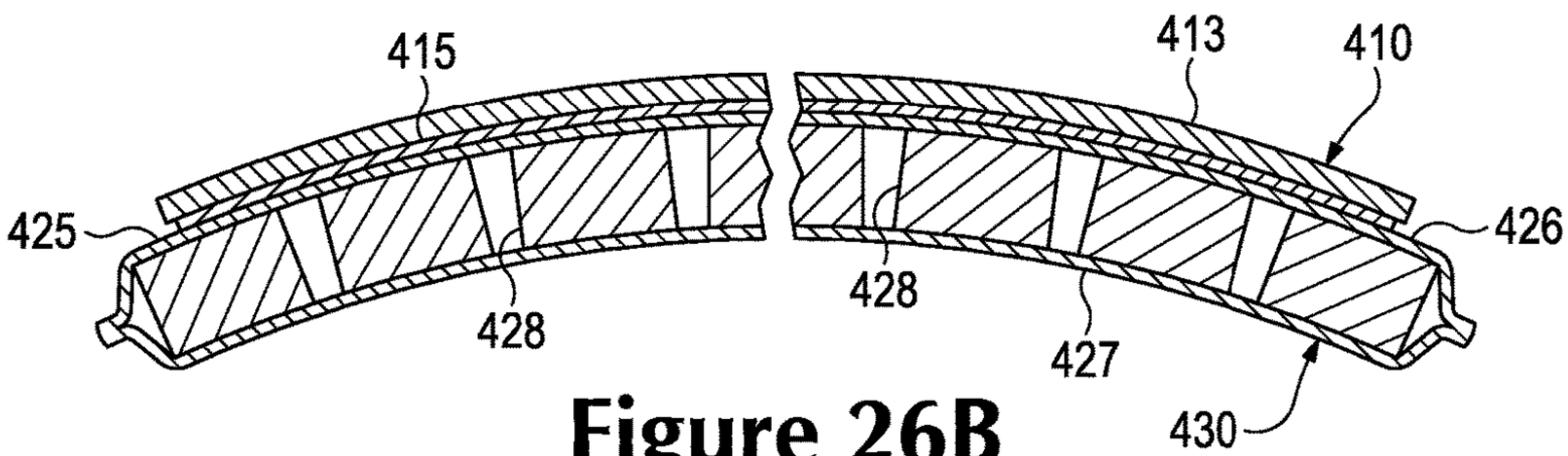


Figure 26B

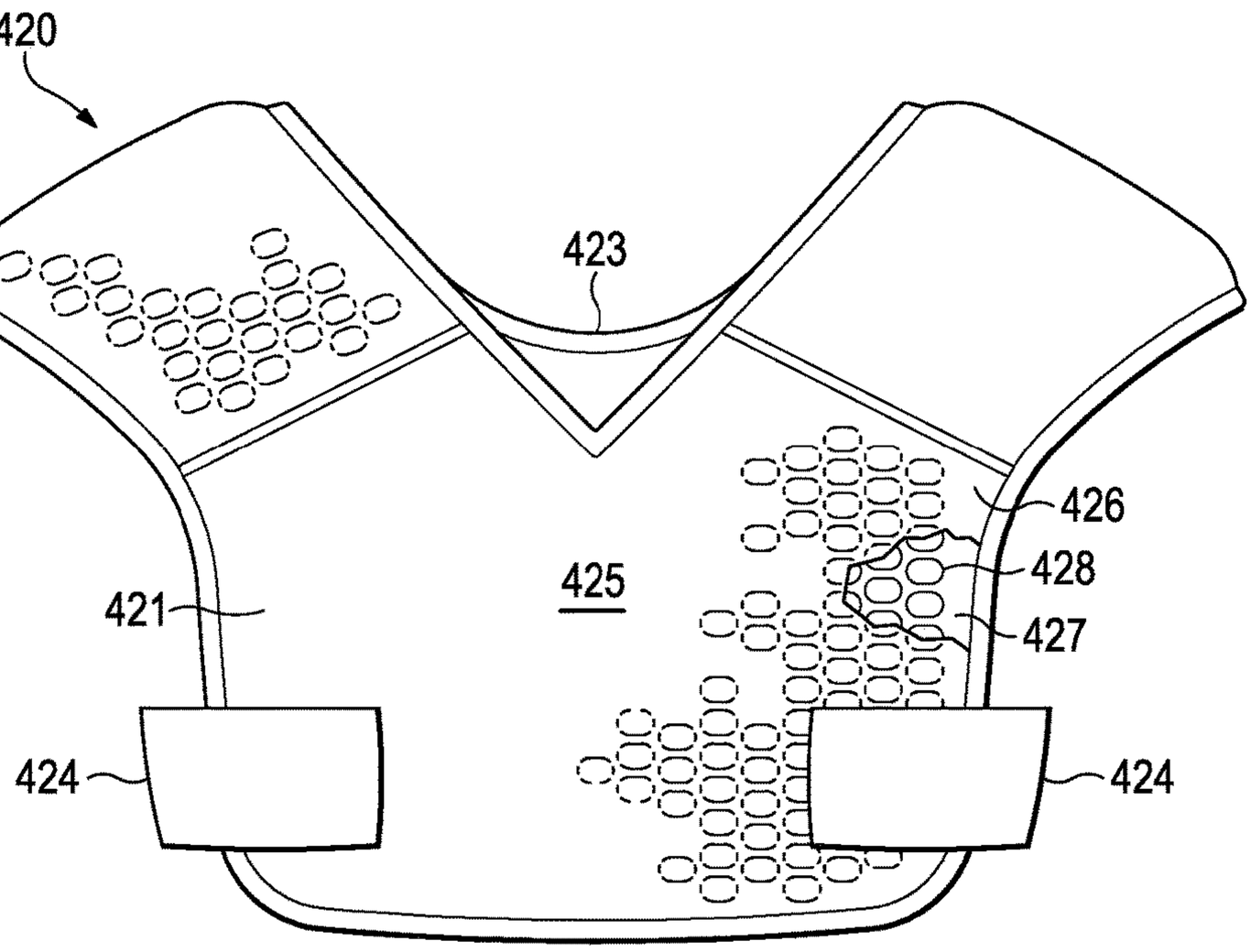


Figure 27

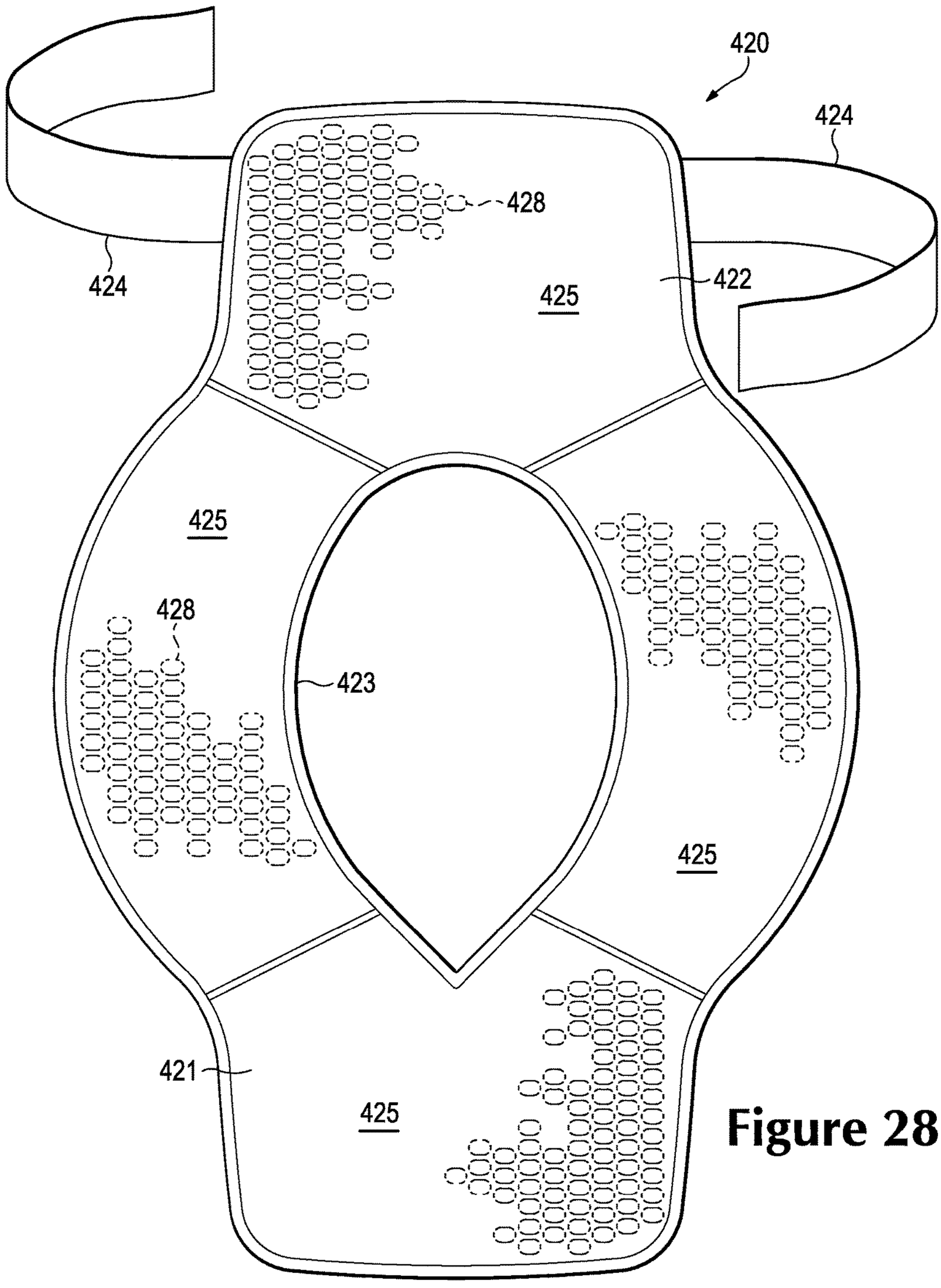
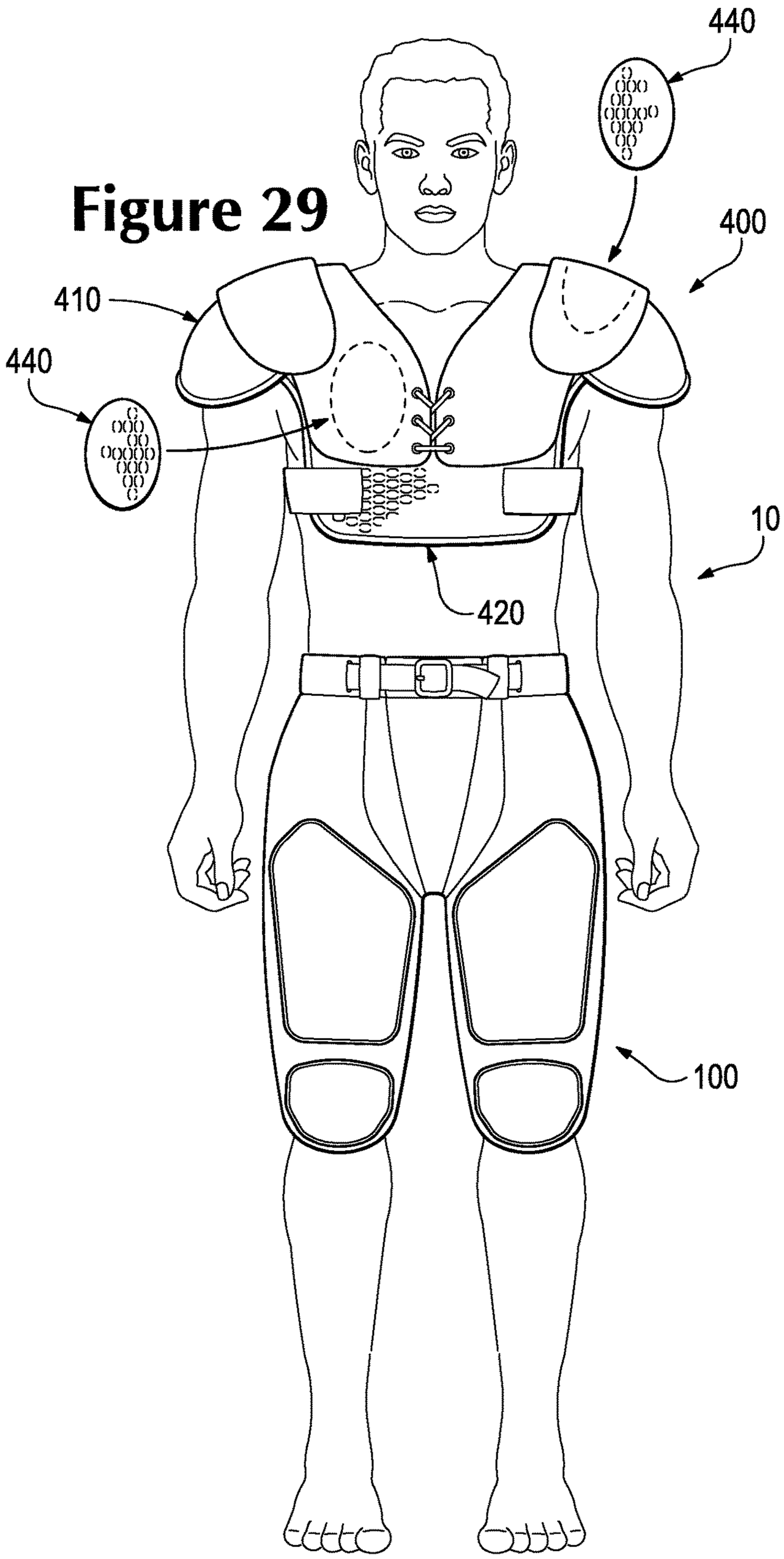


Figure 28

Figure 29



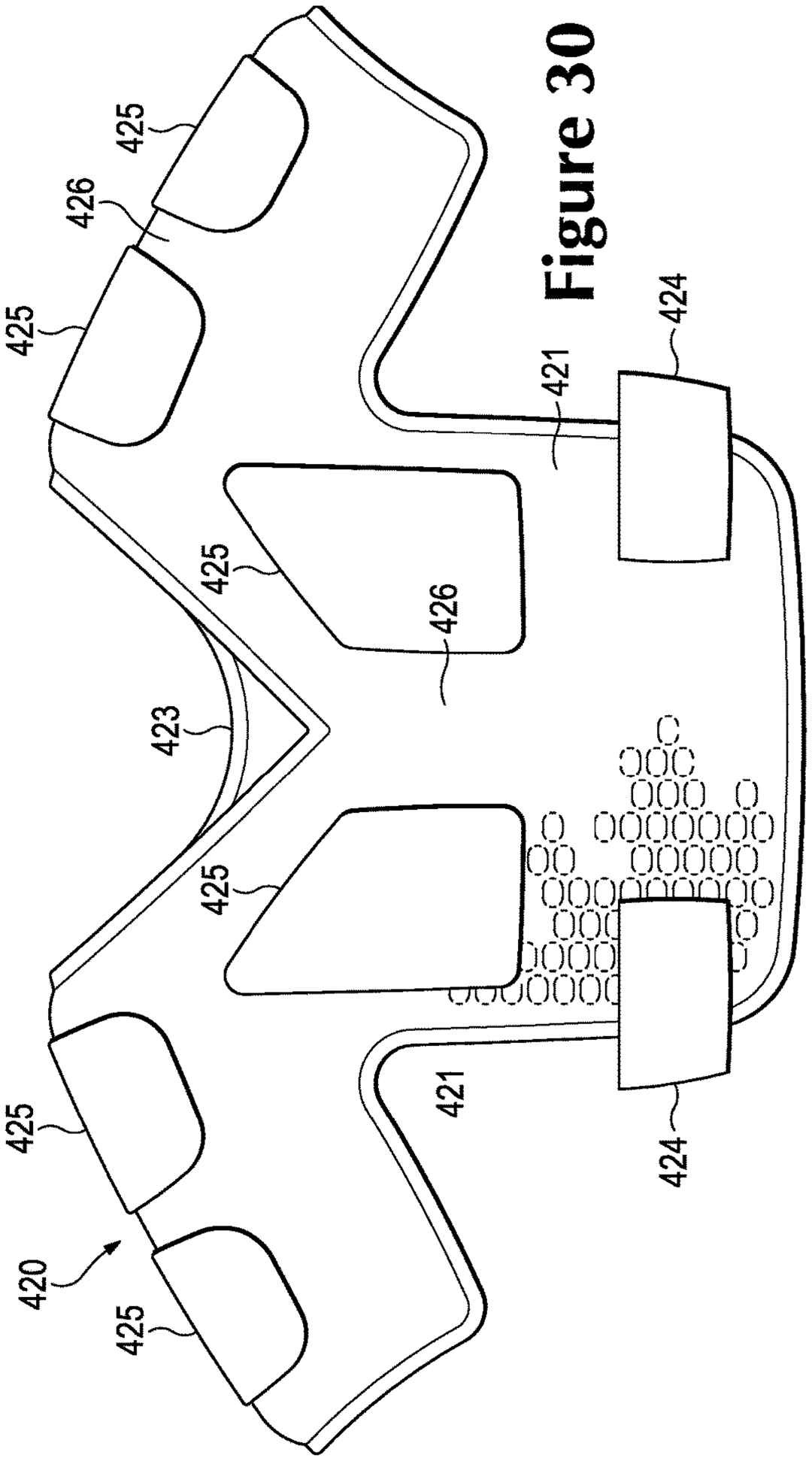


Figure 30

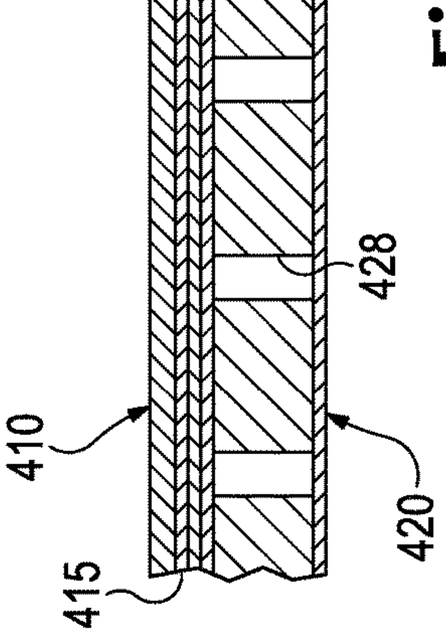


Figure 31

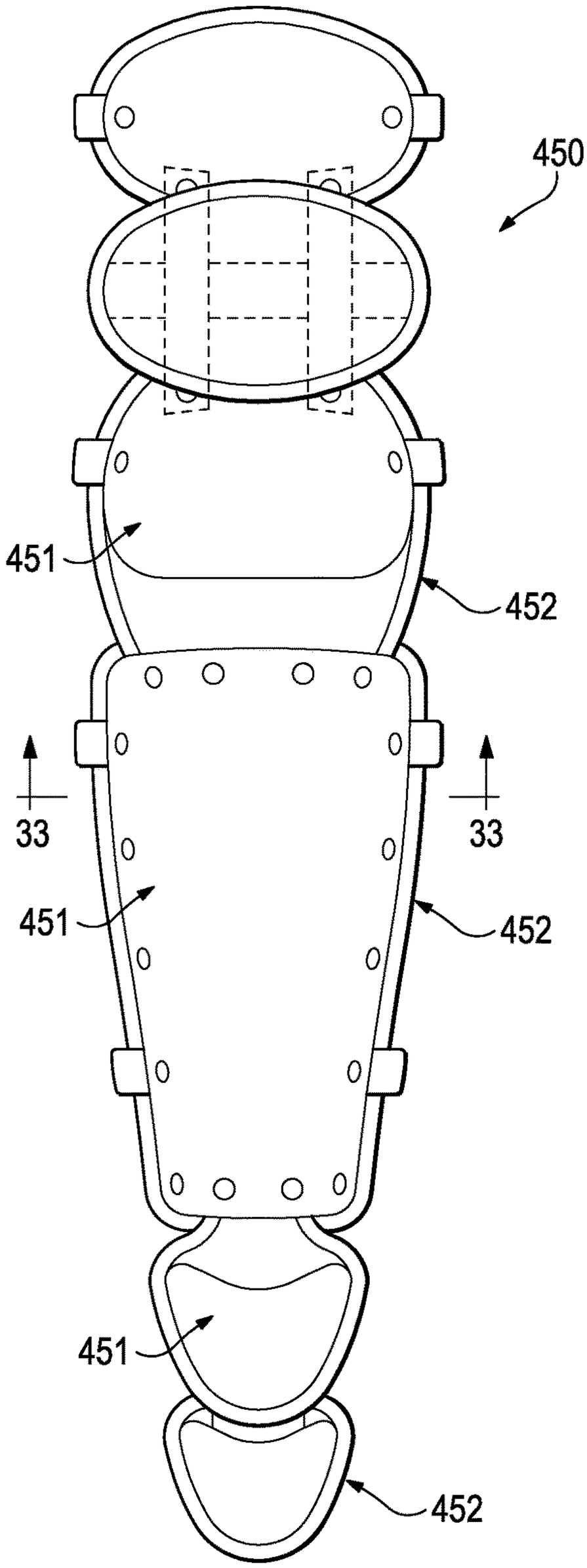


Figure 32

Figure 33

APPAREL INCORPORATING A PROTECTIVE ELEMENT

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of U.S. Patent Publication Number 2014/0245525 (filed on Jun. 26, 2013, as U.S. patent application Ser. No. 13/927,436), which is a continuation-in-part of U.S. patent application Ser. No. 13/889,018 (filed on May 7, 2013, and issued as U.S. Pat. No. 8,713,719), which is a continuation of U.S. patent application Ser. No. 13/111,461 (filed on May 19, 2011, and issued as U.S. Pat. No. 8,438,669), which is a continuation-in-part of U.S. patent application Ser. No. 12/490,001 (filed Jun. 23, 2009, and issued as U.S. Pat. No. 8,095,996). The disclosures of all of the aforementioned patent documents are hereby incorporated by reference in their respective entirety.

BACKGROUND

Articles of athletic apparel commonly incorporate elements that cushion or protect an athlete from contact with other athletes, equipment, or the ground. Examples of these elements include (a) foam components that impart cushioning or otherwise attenuate impact forces and (b) rigid or semi-rigid plates that distribute impact forces. Many articles of athletic apparel combine foam components and plates to protect to the athlete by both attenuating and distributing impact forces. That is, the combination of a foam component and a plate may impart enhanced protection by both attenuating and distributing impact forces. As an example, shoulder pads and thigh pads worn under uniforms in American football include (a) foam components located adjacent to the athlete (i.e., in contact with the athlete or apparel worn adjacent to the skin of the athlete) and (b) plates secured to the foam components and located opposite the athlete. As another example, helmets utilized during American football, bicycling, hockey, skiing, snowboarding, and skateboarding also effectively combine polymer foam components with an external plate (i.e., the exterior of the helmet). Additionally, shin guards worn for soccer and leg guards worn for baseball include polymer foam components and an external plate.

SUMMARY

Various protective elements that may be utilized in articles of protective apparel are disclosed below. The apparel may include a plate element and a cushioning element. The plate element has a first part of a hook-and-loop fastening system, and the cushioning element incorporates a second part of the hook-and-loop fastening system. The first part of the hook-and-loop fastening system is joinable to the second part of the hook-and-loop fastening system to secure the plate element to the cushioning element.

Aspects of the technology are defined by the claims below, not this Summary. A high-level overview of various aspects of the invention is provided here to introduce a selection of concepts that are further described below in the detailed-description section. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in isolation to determine the scope of the claimed subject matter.

FIGURE DESCRIPTIONS

The foregoing Summary and the following Detailed Description will be better understood when read in conjunction with the accompanying figures, which are incorporated herein by reference and include the below listed figures.

FIG. **1** is a front elevational view of an individual wearing an apparel system having an outer garment and an inner garment.

FIG. **2** is an exploded front elevational view of the individual wearing the apparel system.

FIG. **3** is a front elevational view of the outer garment.

FIGS. **4** and **5** are side elevational views of the outer garment.

FIG. **6** is a rear elevational view of the outer garment.

FIGS. **7**A and **7**B are cross-sectional views of the outer garment, as defined by section lines **7**A and **7**B in FIG. **3**.

FIG. **8** is a front elevational view of the inner garment.

FIG. **9** is an exploded front elevational view of the inner garment.

FIGS. **10** and **11** are side elevational views of the inner garment.

FIG. **12** is a rear elevational view of the inner garment.

FIG. **13** is a perspective view of a protective component of the inner garment.

FIG. **14** is an exploded perspective view of the protective component.

FIG. **15** is a top plan view of the protective component.

FIGS. **16**A and **16**B are cross-sectional views of the protective component, as defined by section lines **16**A and **16**B in FIG. **15**.

FIGS. **17**A and **17**B are exploded cross-sectional views respectively corresponding with the cross-sectional views of FIGS. **16**A and **16**B.

FIGS. **18**A-**18**G are exploded perspective views corresponding with FIG. **14** and depicting further configurations of the protective component.

FIGS. **19**A-**19**E are top plan views corresponding with FIG. **15** and depicting further configurations of the protective component.

FIGS. **20**A-**20**C are cross-sectional views corresponding with FIG. **16**A and depicting further configurations of the protective component.

FIG. **21** is a front elevational view of the individual wearing an article of protective apparel having a configuration of shoulder pads and including a plate element and a cushioning element.

FIG. **22** is a front elevational view of the individual wearing the cushioning element.

FIG. **23** is a front elevational view of the article of protective apparel.

FIG. **24** is a rear elevational view of the article of protective apparel.

FIG. **25** is an exploded front elevational view of the article of protective apparel.

FIGS. **26**A and **26**B are cross-sectional views of the article of protective apparel, as defined by section lines **26**A and **26**B in FIG. **23**.

FIG. **27** is a front elevational view of the cushioning element.

FIG. **28** is a plan view of the cushioning element in a flat configuration.

FIG. **29** is a front elevational view of the individual wearing another configuration of the article of protective apparel.

FIG. **30** is a front elevational view of another configuration of the cushioning element.

FIG. **31** is a cross-sectional view corresponding with FIG. **26**A and depicting the article of protective apparel as incorporating the cushioning element from FIG. **30**.

FIG. **32** is a front elevational view of an article of protective apparel having a configuration of a leg guard.

FIG. **33** is a cross-sectional view of the article of protective apparel, as defined by section line **33** in FIG. **32**.

DETAILED DESCRIPTION

The subject matter of aspects of the technology is described with specificity herein to meet statutory requirements. But the description itself is not intended to necessarily limit the scope of claims. Rather, the claimed subject matter might be embodied in other ways to include different steps or combinations of steps similar to the ones described in this document, in conjunction with other present or future technologies. The following discussion and accompanying figures disclose various apparel systems, articles of apparel, and protective components that may be incorporated into the apparel systems or articles of apparel.

Apparel System

With reference to FIGS. **1** and **2**, an individual **10** is depicted as wearing an apparel system **100** that includes an outer garment **200** and an inner garment **300**. Each of garments **200** and **300** exhibit the general configuration of a pants-type garment, which includes any of a plurality of articles of apparel that cover a portion of a pelvic area of individual **10** and may extend over legs of individual **10**. Although garments **200** and **300** are each depicted as being pairs of shorts, various concepts disclosed below for garments **200** and **300** may also be applied to other pants-type garments, including pants, briefs, jeans, and underwear. The various concepts disclosed below for garments **200** and **300** may also be applied to shirt-type garments, which cover a portion of a torso area of individual **10** and may extend over arms of individual **10**. Examples of shirt-type garments include long-sleeved shirts, short-sleeved shirts, tank tops, undershirts, jackets, and coats. In some configurations, articles of apparel incorporating concepts disclosed below for garments **200** and **300** may be combinations of shirt-type garments and pants-type garments, including bodysuits, leotards, unitards, and wetsuits. In addition, articles of apparel incorporating concepts disclosed below for garments **200** and **300** may have configurations that cover other areas of individual **10**, such as hats, helmets, arm and leg wraps, gloves, socks, and footwear, for example.

Although apparel system **100** may be worn alone or exposed, apparel system **100** may also be worn in combination with other articles of apparel (e.g., under or over other articles of apparel). Apparel system **100** may also be worn in combination with other pieces of equipment (e.g., athletic or protective equipment). In general, outer garment **200** is worn over inner garment **300**, thereby positioning outer garment **200** to be exterior of inner garment **300**. Whereas inner garment **300** may be worn in contact with and to cover individual **10**, outer garment **200** may be worn in contact with and to cover inner garment **300**. That is, inner garment **300** is generally positioned between individual **10** and outer garment **200**. Depending upon various factors (e.g., sport, activity, weather, preferences), the other articles of apparel or pieces of equipment may be worn (a) between inner garment **300** and individual **10**, (b) between garments **200** and **300**, or (c) exterior of outer garment **200**. Accordingly, the configuration of apparel system **100**, including each of the individual garments **200** and **300**, and the manner in which apparel system **100** is worn by individual **10** may vary significantly.

Apparel system **100** incorporates various cover components **210** and protective components **305**. More particularly, outer garment **200** includes cover components **210**, and inner garment **300** includes protective components **305**. Although cover components **210** and protective components **305** may each be utilized individually to impart padding, cushioning, or otherwise distribute or attenuate impact forces, thereby imparting protection to individual **10**, components **210** and **305** may also operate cooperatively to impart protection to individual **10**. For example, some cover components **210** may overlap, extend over, or otherwise coincide with the positions of some protective components **305**. In areas where cover components **210** extend over protective components **305**, both elements **210** and **305** may impart protection to individual **10**. Additional details concerning garments **200** and **300**, as well as components **210** and **305**, will be discussed below.

Outer Garment Configuration

Outer garment **200**, which incorporates cover components **210**, is depicted individually in FIGS. **3-6** as including a pelvic region **201** and a pair of leg regions **202** that extend outward and downward from pelvic region **201**. Pelvic region **201** corresponds with the pelvic area of individual **10** and extends over at least a portion of the pelvic area when worn. An upper portion of pelvic region **201** defines a waist opening **203** that extends around a waist of individual **10** when outer garment **200** is worn. Leg regions **202** correspond with a right leg and a left leg of individual **10** and cover at least a portion of the right leg and the left leg when worn. Lower portions of leg regions **202** each define a thigh opening **204** that extends around a thigh of individual **10** when outer garment **200** is worn.

Cover components **210** are incorporated into various areas of outer garment **200** to impart padding, cushioning, or otherwise attenuate impact forces, thereby imparting protection to individual **10**. Two lower cover components **210** are located in a front area of leg regions **202** and adjacent to thigh openings **204**, and two upper cover components **210** are also located in the front area of leg regions **202** and extend upward and into lower areas of pelvic region **201**. As discussed above, cover components **210** may overlap, extend over, or otherwise coincide with the positions of some protective components **305** of inner garment **300**. Whereas the upper cover components **210** coincide in location and extend over two of protective components **305**, the lower cover components **210** are positioned separate from protective components **305**. In this configuration, the upper cover components **210** and two of protective components **305** cooperatively impart protection to areas of individual **10**, while the lower cover components **210** individually impart protection to areas of individual **10**. In further configurations of apparel system **100** or outer garment **200**, cover components **210** may be positioned in various areas of outer garment **200**, including the sides or back of leg regions **202** or in pelvic region **201**, to protect specific portions (e.g., muscles, bones, joints, impact areas) of individual **10**. Additionally, the quantity, shapes, sizes, and other properties of cover components **210**, as well as the materials utilized in cover components **210**, may vary significantly to provide a particular level of protection to the specific portions of individual **10**.

One of cover components **210** is depicted in the cross-sectional views of FIGS. **7**A and **7**B as including a first material layer **211**, a second material layer **212**, and a pad

213. In general, pad 213 is positioned between and secured to first material layer 211 and second material layer 212. Material layers 211 and 212 cooperatively form an outer surface or covering for protective elements 210. That is, material layers 211 and 212 cooperatively form a pocket or void, in which pad 213 is located. Whereas second material layer 212 is depicted as having a generally planar configuration, first material layer 211 extends over pad 213 and also along sides of pad 213 to join with second material layer 212 (e.g., through stitching, an adhesive, or thermal bonding). Although cover component 210 may be incorporated into outer garment 200 in a variety of ways, first material layer 211 may be positioned exterior of second material layer 212. That is, first material layer 211 may form a portion of an exterior surface of outer garment 200, whereas second material layer 212 may form a portion of an interior surface of outer garment 200. An advantage to this configuration is that cover component 210 protrudes outward from outer garment 200, rather than protruding inward and toward individual 10. In some configurations of outer garment 200, however, cover component 210 may protrude inward.

A thickness of pad 213 may vary depending upon various factors, including the type of material utilized for pad 213 and the desired level of protection. In general, however, the thickness of pad 213 may range from one to fifty millimeters or more when formed from a polymer foam material. Although pad 213 may exhibit a constant thickness between material layers 211 and 212, the thickness may vary across the width of pad 213. For example, edges of pad 213 may be thinner than central areas of pad 213. Various apertures, gaps, and indentations may also be formed in pad 213 to enhance flexibility and breathability.

A variety of materials may be utilized for first material layer 211 and second material layer 212, including various textiles, polymer sheets, leather, or synthetic leather, for example. Combinations of these materials (e.g., a polymer sheet bonded to a textile) may also be utilized for material layers 211 and 212. Although material layers 211 and 212 may be formed from the same material, each of material layers 211 and 212 may also be formed from different materials. With regard to textiles, material layers 211 and 212 may be formed from knitted, woven, or non-woven textile elements that include rayon, nylon, polyester, polyacrylic, cotton, wool, or silk, for example. Moreover, the textiles may be non-stretch, may exhibit one-directional stretch, or may exhibit multi-directional stretch. Accordingly, a variety of materials are suitable for first material layer 211 and second material layer 212. As will be described in other part of this Detailed Description, material layers of the inner garment 300 may include one or more layers that are similar to the material layers of the outer garment or that include materials described with respect to the material layers of the outer garment.

Pads 213 may also be formed from a variety of materials, including various polymer foam materials that return to an original shape after being compressed. As an alternative to polymer foam materials, pads 213 may also be formed as fluid-filled chambers. Examples of suitable polymer foam materials for pads 213 include polyurethane, ethylvinylacetate, polyester, polypropylene, and polyethylene foams. Moreover, both thermoplastic and thermoset polymer foam materials may be utilized. In some configurations of cover components 210, pads 213 may be formed from a polymer foam material with a varying density, or solid polymer or rubber materials may be utilized. Also, different pads 213 may be formed from different materials, or may be formed from similar materials with different densities. Additional articles of apparel having features that may be utilized in outer apparel 200 or for pads 213 are disclosed in U.S. patent application Ser. No. 11/620,950, filed 8 Jan. 2007 and entitled Athletic Garment With Articulated Body Protective Underlayer, which is entirely incorporated herein by reference.

The polymer foam materials forming pads 213 of cover components 210 attenuate impact forces to provide protection. When incorporated into apparel system 100 and outer garment 200, the polymer foam materials of pads 213 may compress to protect a wearer from contact with other athletes, equipment, or the ground. Accordingly, cover components 210 may be utilized to provide protection to areas of individual 10 that are covered by cover component 210. As discussed above, cover components 210 may overlap, extend over, or otherwise coincide with the positions of some protective components 305 of inner garment 300. In this position, cover components 210 may be utilized to provide protection to other athletes or individuals from relatively hard or rigid materials (e.g., a plate) incorporated into protective components 305. As will be described in other part of this Detailed Description, a pad of the inner garment 300 may include aspects similar to the elements described with respect to the pad(s) of the outer garment.

Inner Garment Configuration

Inner garment 300, which incorporates protective components 305, is depicted individually in FIGS. 8-12 as including a pelvic region 301 and a pair of leg regions 302 that extend outward or downward from pelvic region 301. Pelvic region 301 corresponds with the pelvic area of individual 10 and extends over at least a portion of the pelvic area when worn. Pelvic region 301 also corresponds with pelvic region 201 of outer garment 200 and is generally located between pelvic region 201 and individual 10 when worn. An upper portion of pelvic region 301 defines a waist opening 303 that extends around a waist of individual 10 when outer garment 300 is worn. Leg regions 302 correspond with a right leg and a left leg of individual 10 and cover at least a portion of the right leg and the left leg when worn. Leg regions 302 also correspond with leg regions 202 of outer garment 200 and are generally located between leg regions 202 and individual 10 when worn. Lower portions of leg regions 302 each define a thigh opening 304 that extends around a thigh of individual 10 when inner garment 300 is worn.

Protective components 305 are incorporated into various areas of inner garment 300 to impart padding, cushioning, or otherwise attenuate impact forces, thereby imparting protection to individual 10. More particularly, two of protective components 305 are located in a front area of leg regions 302, two of protective components 305 are located on sides of pelvic region 301, and one of protective components 305 is in a back of pelvic region 301. In further configurations of apparel system 100 or inner garment 300, protective components 305 may be positioned in various areas of inner garment 300, including the sides or back of leg regions 302 or other areas of pelvic region 301, to protect specific portions (e.g., muscles, bones, joints, impact areas) of individual 10. Additionally, the quantity, shapes, sizes, and other properties of protective components 305, as well as the materials utilized in protective components 305, may vary significantly to provide a particular level of protection to the specific portions of individual 10.

As discussed above, cover components 210 of outer garment 200 may overlap, extend over, or otherwise coincide with the positions of some protective components 305. Although outer garment 200 may cover substantially all of

inner garment **300** and the various protective components **305**, only the upper cover components **210** coincide in location and extend over the two protective components **305** in the front area of leg regions **302**. In further configurations of apparel system **100**, however, additional cover components **210** may extend over other protective components **305**.

Protective Element Configurations

An example configuration for one of protective components **305** is depicted in FIGS. **13-17**B as including a cushioning element **310** and a plate element **315**. Cushioning element **310** includes a first material layer **311**, a second material layer **312**, a plurality of pads **313**, a frame **314**, and a plate element **315**. In general, pads **313** and frame **314** are positioned between first material layer **311** and second material layer **312**. Although pads **313** are secured to first material layer **311** and second material layer **312**, frame **314** is unsecured to each of first material layer **311**, second material layer **312**, and pads **313**. Additionally, plate element **315** is located at an exterior of cushioning element **310** (i.e., located exterior of first material layer **311**). Although each cushioning element **310** in the front area of leg regions **302** incorporate one of plate elements **315**, further plates are absent from other cushioning elements **310**. In further configurations, additional plate elements **315** may be utilized in the other cushioning elements **310**.

First material layer **311** and second material layer **312** cooperatively form an outer surface or covering for cushioning element **310**, with plate element **315** being secured to the outer surface. That is, first material layer **311** and second material layer **312** cooperatively form a pocket or void, in which pads **313** and frame **314** are located. Whereas second material layer **312** is depicted as having a generally planar configuration, first material layer **311** extends over pads **313** and frame **314** and also along sides of pads **313** to join with second material layer **312** (e.g., through stitching, an adhesive, or thermal bonding). Although cushioning element **310** may be incorporated into inner garment **300** in a variety of ways, first material layer **311** may be positioned exterior of second material layer **312**. That is, first material layer **311** may form a portion of an exterior surface of inner garment **300**, whereas second material layer **312** may form a portion of an opposite interior surface of inner garment **300**. An advantage to this configuration is that cushioning element **310** protrudes outward from inner garment **300**, rather than protruding inward and toward individual **10**. In some configurations of inner garment **300**, however, cushioning element **310** may protrude inward.

Any of the various materials discussed above for material layers **211** and **212** may be utilized for first material layer **311** and second material layer **312**. For example, the second material layer **312** may include part of a base layer that forms at least part of the inner garment **300**. Alternatively, second material layer **312** may be an additional layer that is coupled to an outward-facing surface of the inner garment **300**, such as by stitching, bonding, adhering, welding, etc. In a further aspect, the second material layer **312** includes a knitted, woven, or non-woven textile that at least partially includes rayon, nylon, polyester, polyacrylic, cotton, wool, or silk, for example. Moreover, the textiles of second material layer **312** may be non-stretch, may exhibit one-directional stretch, or may exhibit multi-directional stretch. In a further aspect, the first material layer **311** may be either the same material as the second material layer **312** or a material that is different from the second material layer **312**. For example, the first material layer **311** may include a textile that is perforated (e.g., mesh) to provide added ventilation and breathability. The first material layer **311** may also include a polymer sheet, such as a thermoplastic sheet (e.g., thermoplastic polyurethane) that is affixable to the second material layer **312** and to the pad **313**.

Pads **313** are located between and secured to each of material layers **311** and **312**. Each of pads **313** has a first surface **321** secured to first material layer **311**, an opposite second surface **322** secured to second material layer **312**, and a side surface **323** that extends between surfaces **321** and **322**. Although the shapes of pads **313** may vary significantly, many of surfaces **321** and **322** are depicted as having an elliptical or generally elongate shape with rounded end areas, and side surface **323** extends in a generally straight fashion between surfaces **321** and **322**. Pads **313** are spaced evenly from each other and arranged in offset rows.

The pads **313** are generally depicted in some of the figures as discrete elements that are spaced from each other, but the pad elements may also be connected or formed as a one-piece unit. That is, in an aspect of the present invention, a plurality of the pads **313** are connected to another to form a single, integrated pad. For example, a single, integrated pad may be cast (e.g., from a polymer foam), or otherwise molded, to include a plurality connected pads **313**. In another aspect, a single sheet of padding material might be routered, milled, heat pressed, or manufactured using some other subtractive manufacturing technique in order to create grooves or reduced-thickness portions between the pads **313**.

Given that cushioning element **310** is depicted as having a generally pentagonal configuration, various pads **313** around a perimeter of cushioning element **310** exhibit a truncated or partial configuration. Some of pads **313** also define apertures **324** that receive elements for securing plate element **315**, and these pad components may be larger than other pad components **315**. A variety of materials may be utilized for pads **313**, including any of the various materials discussed above for pad **213**, such as polymer foam materials and fluid-filled chambers.

Each of pads **313** are depicted as having the same thickness (i.e., distance between surfaces **321** and **322**), which may range from one to fifty millimeters or more when formed from a polymer foam material. As an alternative, pads **313** may exhibit varying thicknesses. For example, a group of pads **313** located in a central area of cushioning element **310** may exhibit a maximum thickness, a group of pads **313** located around the central area may exhibit a medium thickness, and a group of pads **313** located adjacent to a periphery of cushioning element **310** may exhibit a minimum thickness. A configuration of a cushioning element with varying thicknesses is disclosed in U.S. Provisional Patent Application Ser. No. 61/158,653, filed 9 Mar. 2009 and entitled Cushioning Elements For Apparel And Other Products, which is entirely incorporated herein by reference.

Frame **314** is located between each of material layers **311** and **312**. In contrast with pads **313**, frame **314** is unsecured to each of first material layer **311** and second material layer **312**, and frame **314** is also unsecured to pads **313**. This configuration permits frame **314** to float or otherwise move relative to first material layer **311**, second material layer **312**, and pads **313**. Frame **314** defines a plurality of apertures **325** having the general shape of pads **313**. Given this configuration, frame **314** extends around and between various pads **313**. In areas where frame **314** is present, the combination of pads **313** and frame **314** effectively forms a foam layer within cushioning element **310**. Although the dimensions of apertures **325** may substantially match the dimensions of

pads **313**, frame **314** may also be formed such that a gap extends between edges of apertures **325** and side surfaces **233** of pads **313**. Any of the variety of materials discussed above as being suitable for pads **213** and **313** may also be utilized for frame **314**.

Frame **314** is depicted as being located in the central area of cushioning element **310**. As an alternative, frame **314** may extend (a) throughout cushioning element **310** and define apertures **325** that extend around all of pads **313**, (b) around other pads **313**, or (c) through other areas of cushioning element **310**. Additionally, frame **314** may extend to the periphery of cushioning element **310** in some areas, but not in other areas. Accordingly, the portions of cushioning element **310** into which frame **314** extends may vary significantly.

Referring to the cross-sectional views of FIGS. **16**A and **16**B, for example, frame **314** is depicted as exhibiting lesser thickness than each of pads **313**. An advantage of this configuration is that frame **314** may move relative to material layers **311** and **312**, thereby enhancing the flexibility of cushioning element **310**. As an example, frame **314** may have a thickness of approximately two millimeters in a configuration wherein the pads **313** exhibit a thickness of five millimeters. In other configurations, the thickness of frame **314** may range from one to fifty millimeters or more. Although frame **314** may exhibit lesser thickness than pads **313**, frame **314** may also be thicker than pads **313**.

A variety of methods may be utilized to manufacture cushioning element **310**. In general, the methods include bonding (e.g., adhesive or thermal bonding) each of pads **313** to material layers **311** and **312**. Examples of suitable manufacturing processes are disclosed in (a) U.S. patent application Ser. No. 12/755,579, which was filed in the U.S. Patent and Trademark Office on 7 Apr. 2010 and entitled Method Of Manufacturing Cushioning Elements For Apparel And Other Products; (b) U.S. patent application Ser. No. 13/035,570, which was filed in the U.S. Patent and Trademark Office on 25 Feb. 2011 and entitled Cushioning Elements For Apparel And Other Products And Methods Of Manufacturing The Cushioning Elements; and (c) U.S. patent application Ser. No. 13/035,592, which was filed in the U.S. Patent and Trademark Office on 25 Feb. 2011 and entitled Articles Of Apparel Incorporating Cushioning Elements And Methods Of Manufacturing The Articles Of Apparel, each of which are entirely incorporated herein by reference.

Plate element **315** is positioned exterior of material layers **311** and **312**, pads **313**, and frame **314**. Whereas pads **313** and frame **314** are located between material layers **311** and **312**, plate element **315** is located on an opposite side of first material layer **311** and forms a portion of an exterior surface of inner garment **300** and protective component **305**. As described in greater detail below, plate element **315** has a semi-rigid structure that distributes impact forces over pads **313** to impart protection to individual **10** or another wearer.

Various securing elements **326** are utilized to secure plate element **315** to cushioning element **310**. Securing elements **326** extend through apertures **327** in plate element **315** and also extend through corresponding apertures **324** in selected pads **313**, as well as holed in material layers **311** and **312**. Although securing elements **326** are depicted as having the general configuration of rivets, various snap-fit securing mechanisms, adhesive or thermal bonding, or stitching may be utilized to join plate element **315**. In some configurations, plate element **315** may also be secured with a hook-and-loop fastener that permits plate element **315** to be separated, repositioned, or replaced.

Plate element **315** has an overall curved configuration that generally conforms with a shape of individual **10**. Given that protective component **305** may be utilized to protect a thigh of individual **10**, plate element **315** may exhibit a curvature that corresponds with the thigh. Additionally, plate element **315** may include various ribs **328** that enhance rigidity. In further configurations, plate element **315** may have a variety of other features that enhance the comfort or protective properties of apparel system **100** or protective component **305**. For example, plate element **315** may define a plurality of apertures that enhance breathability or flexibility, plate element **315** may be formed from multiple materials that vary the rigidity or flexibility in different areas, or plate element **315** may have a varying thickness that also vary the rigidity or flexibility in different areas.

Plate element **315** is depicted as having lesser area than first material layer **211**. In this configuration, some of pads **313** are located adjacent to plate element **315** (i.e., covered by plate element **315**), and some of pads **313** are located around a periphery of plate element **315**. That is, plate element **315** only covers a central portion of pads **313**, but effectively exposes peripheral portions of pads **313**. Forming plate element **315** in this manner imparts a varying thicknesses to cushioning element **310**. An advantage of three varying thicknesses relates to the comfort of apparel system **100** and the integration of inner garment **300** with other articles of apparel (e.g., outer garment **200**) or other articles of equipment. The lesser thickness of the periphery of cushioning element **310** imparts a lower profile at the periphery. Given the lower profile, portions of cushioning element **310** at the periphery may be less noticeable to individual **10** and may interfere less with the other articles of apparel or equipment. Moreover, plate element **315** may have a conventional size, but the protective properties of pads **313** may extend beyond plate element **315** to cover further and larger areas of individual **10**.

As a comparison with the compressible polymer foam material forming pads **313** and frame **314**, plate element **315** may be formed from a semi-rigid or rigid polymer material with greater stiffness and density than the polymer foam material. As another comparison, whereas pads **313** and frame **314** may be formed from a polymer foam material, plate element **315** may include a non-foamed polymer material. Examples of suitable polymer materials for plate element **315** include polyethylene, polypropylene, acrylonitrile butadiene styrene, polyester, thermoset urethane, thermoplastic urethane, polyether block amide, polybutylene terephthalate various nylon formulations, or blends of these materials. Composite materials may also be formed by incorporating glass fibers, aramid fibers, or carbon fibers, for example, into the polymer materials discussed above in order to enhance the strength and rigidity of plate element **315**. In some configurations, plate element **315** may also be formed from metal materials (e.g., aluminum, titanium, steel) or may include metal elements that enhance the strength and rigidity of plate element **315**. Accordingly, a variety of materials may be utilized for plate element **315**.

Cushioning element **310** and plate element **315** cooperatively impart protection to individual **10**. An impact force contacting plate element **315**, for example, is distributed over many of pad components **314**, which cushion or otherwise attenuate the impact force. That is, the rigid or semi-rigid polymer material forming plate element **315** distributes impact forces, and the compressible polymer foam materials of pads **313** impart cushioning or otherwise attenuate the impact forces. When incorporated into apparel system **100** cover components **210** from outer garment **200**

impart further attenuation of the impact forces and may assist with protecting other individuals.

In addition to distributing and attenuating impact forces, protective component **305** has an advantage of simultaneously providing one or more of breathability, a relatively low overall mass, and launderability. When used for athletic activities, individual **10** may perspire and generate excess heat. By utilizing a permeable textile for material layers **311** and **312** and also forming gaps between adjacent pads **313** and areas between pads **313** and frame **314**, areas for air to enter the apparel and for moisture to exit the apparel are formed through cushioning element **310**. More particularly, air and moisture may pass through material layers **311** and **312**, between pads **313** in areas where frame **314** is absent, and between pads **313** and frame **314** in areas where frame **314** is present to impart breathability to areas of the apparel having cushioning element **310**. Moreover, the materials and structure discussed above for cushioning element **310** impart a low overall mass to cushioning element **310**. Furthermore, the materials and structure discussed above for cushioning element **310** permits cushioning element **310** to be laundered without significant shrinkage or warping, even when temperatures associated with commercial laundering processes are utilized. Accordingly, cushioning element **310** may simultaneously provide impact force distribution, impact force attenuation, breathability, a relatively low overall mass, and launderability to apparel system **100**.

The combination of garments **200** and **300** effectively form a layered structure that includes material layers **211**, **212**, **311**, and **312**; pads **213** and **313**; frame **314**; and plate element **315**. The layered structure has a configuration wherein plate elements **315** are located between polymer foam materials. More particularly, plate elements **315** are located between each of pads **213** and **313**, as well as frame **314**. As discussed above, cover components **210** may overlap, extend over, or otherwise coincide with the positions of some cushioning elements **310** of inner garment **300**, and cover components **210** may be utilized to provide protection to other athletes or individuals from the relatively hard or rigid materials of cushioning elements **310**. In apparel system **100**, cover components **210** overlap only the cushioning elements **310** that incorporate plate elements **315**. Given that plate elements **315** from relatively hard or rigid materials, cover components **210** may be utilized to provide protection to other athletes or individuals from plate elements **315**. Moreover, pads **213** may have a greater area than plate elements **315** such that pads **213** completely cover plate elements **315**. Even if components **210** and **305** move relative to each other, the larger pads **213** may remain in an overlapping configuration with plate elements **315** to continue providing protection to other athletes or individuals from plate elements **315**.

Further Configurations

Aspects of protective components **305** may vary, depending upon the intended use for protective components **305**, the types of apparel that protective components **305** are used in, and their locations within apparel, for example. Moreover, changes to the dimensions, shapes, and materials utilized within protective components **305** may vary the overall properties of protective components **305**. That is, by changing the dimensions, shapes, and materials utilized within protective components **305**, the compressibility, impact force attenuation and distribution, breathability, flexibility, and overall mass of protective components **305** may be tailored to specific purposes or types of apparel. A plurality of variations for protective components **305** are discussed below. Any of these variations, as well as combinations of these variations, may be utilized to tailor the properties of protective components **305** to an intended use or particular product. Moreover, any of the various configurations disclosed in U.S. Provisional Patent Application Ser. No. 61/158,653, which was previously entirely incorporated herein by reference, may be utilized for cushioning element **310**.

A further configuration of protective components **305** is depicted in FIG. **18**A, wherein securing elements **326** are absent. In this configuration, each of pads **313** have similar shapes and do not define apertures (i.e., apertures **324**) for receiving securing elements **326**. In order to secure plate element **315**, adhesive bonding, thermal bonding, or stitching may be utilized. In other configurations, a hook-and-loop fastener system may be utilized to join plate element **315** to cushioning element **310**. Referring to FIG. **18**B, for example, a first part **316** of a hook-and-loop fastener system is secured to an underside of plate element **315** and a second part **317** of the hook-and-loop fastener system is secured to an exterior of first material layer **311**. As another example, FIG. **18**C depicts a similar configuration where first material layer **311** incorporates or is formed by second part **317** of the hook-and-loop fastener system. That is, first material layer **311** may be second part **317** of the hook-and-loop fastener system.

In a further example, FIG. **18**G includes a first part **316** of a hook-and-loop fastener system secured to an underside of plate element **315** and a second part **317** of the hook-and-loop fastener system secured to an exterior of first material layer **311**. The first part **316** of the hook-and-loop fastener system is illustratively depicted as covering an area similar in size as the plate element **315**. But in other aspects, the first part **316** may cover less than the total area of the surface of the plate element **315**. In addition, the second part **317** of the hook-and-loop fastener system may be a strip or sheet of second-part fasteners coupled to the first material layer **311**, or the second part **317** may be incorporated into or form the first material layer **311**. The pad **313**B formed as a one-piece unit from a plurality of pads **313**A that are connected. That is, pads **313**A make up a one-piece, integrated pad **313**B, in which the pads **313**A are delineated by indentions **340** (e.g., elongated grooves). For example, the pad **313**B includes indentions that extend only partially through a thickness of the pad **313**B. Among other things, the indentions **340** may enhance pad flexibility. In a further aspect, the pad **313**B may include apertures that extend entirely through a thickness of the pad **313**B. Another exemplary pad **313**B may not include any indentions and/or apertures. As described in other parts of this description, the first material layer **311** may include various types of materials, such as a knit, woven, non-woven, or polymer-sheet material. In addition, the second material layer **311** may include a same material as the first material layer **311** or may include a material that is different from the first material layer **311**. For example, in one aspect the first material layer **311** includes a polymer-sheet material (e.g., thermoplastic polymer sheet) and the second material layer **312** includes a knit, woven, or non-woven textile. In another aspect, the first material layer **311** includes a mesh-style textile and the second material layer **312** includes a different knit, woven, or non-woven textile. The pad **313**B may be constructed of various types of materials, such as a polymer composition (e.g., polymer foam). For illustrative purposes, the plate **315** is depicted as relatively planar. In another aspect, the plate **315** might include a curved profile shaped to nest with a portion of a wearer (e.g., thigh).

An advantage of utilizing the hook-and-loop fastener system is that plate element **315** may be easily separated, repositioned, or replaced with another plate having a different configuration (e.g., shape, thickness, flexibility). That is, parts **316** and **317** may be separated from each other and then rejoined following repositioning or replacement. Although parts **316** and **317** are depicted as having a size and shape of plate element **315** in FIG. **18**B, either of both of parts **316** and **317** may have any shape or size that facilitates joining and separating plate element **315** from cushioning element **310**. Moreover, cushioning element **310** may be used to impart cushioning and protection without plate element **315** during some activities, and then plate element **315** may be rejoined to cushioning element **310** for other activities. Accordingly, the presence of the hook-and-loop fastening system provides configurability and variability to the use of apparel system **100**.

Further configurations of protective components **305** may include a variety of additional features. As depicted in FIG. **18**D, ribs **328** are absent from plate element **315** and a plurality of apertures **327** extend through plate element **315**. Advantages of the various apertures **327** are that the flexibility and breathability of plate element **315** may be increased. Pads **313** are discussed above as having an elliptical or generally elongate shape with rounded end areas. Pads **313** may, however, have a variety of other shapes, including hexagonal shapes, as depicted in FIG. **18**E. Pads **313** may also have a variety of other shapes, such as round shapes, triangular shapes, rectangular shapes, or irregular shapes. Pads **313** may also have a mixture of different shapes, as depicted in FIG. **18**F. Additionally, frame **314** may be absent from some configurations, as also depicted in FIGS. **18**E and **18**F.

Plate element **315** may cover a majority or even all of cushioning element **310**, as depicted in FIG. **19**A. In further configurations, two or more plate elements **315** may be utilized, as depicted in FIG. **19**B. In addition to changes in the shape of plate element **315**, the overall shape of protective components **305** may vary significantly, as depicted by the rectangular and circular shapes in FIGS. **19**C and **19**D. As noted above with the configuration of FIG. **19**A, two or more plate elements **315** may be utilized. Referring to FIG. **19**E, a similar configuration wherein three separate plate elements **315** overlap each other is depicted to impart flexibility without gaps or other discontinuities between plate elements **315**.

Although the thicknesses of pads **313** may be substantially identical, the thicknesses may also vary, as depicted in FIG. **20**A. The thickness of plate element **315** may also vary. As depicted in FIG. **20**B, the thickness of plate element **315** tapers across the width of cushioning element **310**. In some configurations of cushioning element **310**, securing elements **326** may also be anchored within pads **313**, rather than extending through pads **313**.

Article of Protective Apparel

With reference to FIG. **21**, individual **10** is depicted as wearing an article of protective apparel **400** with the configuration of shoulder pads, which may be utilized in various contact sports, such as American football. Protective apparel **400** includes a plate element **410**, a torso cushioning element **420**, and a pair of shoulder cushioning elements **430**. Plate element **410** covers or extends over an upper torso and shoulders of individual **10**. Torso cushioning element **420** is secured to plate element **410** and located between plate element **410** and individual **10**. Moreover, torso cushioning element **420** covers or extends over the upper torso and a middle torso of individual **10**, thereby extending downward from plate element **410**. Shoulder cushioning elements **430**, which cover or extend over the shoulders, are also secured to plate element **410** and located between plate element **410** and individual **10**. In combination, elements **410**, **420**, and **430** impart padding, cushioning, or otherwise attenuate impact forces, thereby imparting protection to individual **10**.

In the sport of American football, for example, shoulder pads are worn by athletes during athletic competitions. For some athletic training sessions (e.g., practices), however, separate protective pads that do not include plate-like components are worn in place of the shoulder pads. Accordingly, athletic organizations, schools, teams, or the athletes generally purchase or otherwise obtain both the shoulder pads and the protective pads for each of the athletes. An advantage of protective apparel **400**, however, relates to the separability of elements **410** and **420**. During the athletic competitions, the combination of plate element **410**, torso cushioning element **420**, and shoulder cushioning elements **430** may be worn to impart protection to individual **10** from contact with other athletes, equipment, or the ground. During the athletic training sessions, however, torso cushioning element **420** may be separated from plate element **410**, and torso cushioning element **420** may be worn alone, as depicted in FIG. **22**, to provide a moderate degree of protection to individual **10** from contact with other athletes, equipment, or the ground. That is, torso cushioning element **420** may be worn without plate element **410** during the athletic training sessions. Prior to an athletic competition, elements **410** and **420** may be rejoined for use during the athletic competition. As such, athletic organizations, schools, teams, or the athletes may obtain protective apparel **400** to be properly outfitted during both the athletic competitions and the athletic training sessions.

Protective apparel **400** is depicted individually in FIGS. **23-25**. Plate element **410** includes a torso portion **411**, two inner shoulder portions **412**, and two outer shoulder portions **413**. Torso portion **411** covers or otherwise extends over an upper torso of individual **10**. More particularly, torso portion **411** extends over both the chest and back of individual **10**. Torso portion **411** may be formed from a plurality of plate-like components that are joined by various connectors **414**. For example, one of connectors **414** on a front side of plate element **410** has a configuration of a lace that extends repeatedly between two plate-like components, thereby providing some adjustability. Various connectors **414** on a back side of plate element **410** have configurations of straps that extend between two plate-like components.

Shoulder portions **412** and **413** also have the configuration of plate-like components and cover or otherwise extend over the shoulders of individual **10**. Inner shoulder portions **412** overlap spaces between torso portion **411** and outer shoulder portions **413**. In some configurations, each of shoulder portions **412** and **413** are flexibly-secured to torso portion **411**. In other configurations, outer shoulder portions **413** are flexibly-secured to inner shoulder portions **412**, and inner shoulder portions **412** are flexibly-secured to torso portion **411**. In either configuration, shoulder portions **412** and **413** are secured at opposite sides of torso portion **411**.

Plate element **410** is primarily formed from a semi-rigid or rigid polymer material, which may be a non-foamed polymer material. Examples of suitable polymer materials for plate element **410** (i.e., portions **411**, **412**, and **413**) include polyethylene, polypropylene, acrylonitrile butadiene styrene, polyester, thermoset urethane, thermoplastic urethane, polyether block amide, polybutylene terephthalate various nylon formulations, or blends of these materials. Composite materials may also be formed by incorporating

glass fibers, aramid fibers, or carbon fibers, for example, into the polymer materials discussed above in order to enhance the strength and rigidity of plate element **410**. In some configurations, plate element **410** may also be formed from metal materials (e.g., aluminum, titanium, steel) or may include metal elements that enhance the strength and rigidity of plate element **410**. Accordingly, a variety of materials may be utilized for plate element **410**.

Torso cushioning element **420** is depicted in combination with plate element **410** in FIGS. **23-25** and is depicted individually in FIGS. **27** and **28**. When secured to plate element **410**, torso cushioning element **420** is located between plate element **410** and individual **10** to cover or extend over the upper torso and middle torso of individual **10**. Although torso cushioning element **420** may have a variety of configurations, torso cushioning element **420** is depicted as including (a) a chest portion **421** that covers or extends over a chest of individual **10**, (b) a back portion **422** that covers or extends over a back of individual **10**, and (c) a neck aperture **423** located between portions **421** and **422** for receiving or extending around a neck of individual **10**. As such, torso cushioning element **420** covers many of the same areas of individual **10** as plate element **410**. In order to impart additional protection, however, torso cushioning element **420** extends downward to cover the middle torso. At the middle torso, therefore, torso cushioning element **420** forms the exterior surface of protective apparel **400**. In order to secure torso cushioning element **420** to individual **10**, two straps **424** extend between lower areas of portions **421** and **422**.

The primary elements of torso cushioning element **420** are a first material layer **426**, a second material layer **427**, and a plurality of compressible pads **428** located between and secured to material layers **426** and **427**, as depicted in FIG. **26**A. In general, torso cushioning element **420** has the configuration of cushioning element **310**. As such, first material layer **426** and second material layer **427** cooperatively form a pocket or void, in which pads **428** are located, and opposite surfaces of pads **428** are secured to material layers **426** and **427**. Although pads **428** are spaced evenly from each other and arranged in offset rows, other configurations for pads **428** may be utilized. Moreover, pads **428** are generally discrete elements that are spaced from each other, but may also be connected or formed as a one-piece unit. Given this configuration, torso cushioning element **420** may simultaneously provide one or more of breathability, a relatively low overall mass, and launderability.

A variety of materials may be utilized for pads **428**, including any of the various materials discussed above for pad **213**, such as polymer foam materials and fluid-filled chambers. As a comparison with the compressible polymer foam material forming pads **428**, plate element **410** is discussed above as including a semi-rigid or rigid polymer material. As such plate element **410** may have greater stiffness and density than the polymer foam material of pads **428**. As another comparison, whereas pads **428** may be formed from a polymer foam material, plate element **410** may include a non-foamed polymer material.

A hook-and-loop fastening system may be used to join plate element **410** and torso cushioning element **420**. More particularly, plate element **410** may include a first part **415** of the hook-and-loop fastening system, and torso cushioning element **420** may incorporate a second part **425** of the hook-and-loop fastening system. Moreover, first part **415** is joinable to second part **425** to secure plate element **410** to torso cushioning element **420**. Referring to FIGS. **23**, **24**, and **26**A, first part **415** may be located on an inner surface of torso portion **411**. Additionally, second part **425** may be incorporated into or otherwise form first material layer **426** of torso cushioning element **420**. As such, first material layer **426** may be second part **425** of the hook-and-loop fastening system.

As discussed above, an advantage of protective apparel **400** relates to the separability of plate element **410** and torso cushioning element **420**. The hook-and-loop fastening system readily permits elements **410** and **420** to be separated and rejoined. As such, elements **410** and **420** may be joined for use during athletic competitions, and elements **410** and **420** may be separated so that torso cushioning element **420** may be used alone during athletic training sessions. Accordingly, the hook-and-loop fastening system facilitates the use of protective apparel **400** during various types of athletic activities.

The pair of shoulder cushioning elements **430**, which are depicted in FIGS. **25** and **26**B, join with outer shoulder portions **413** and cover or otherwise extend over the shoulders of individual **10**. As with torso cushioning element **420**, shoulder cushioning elements **430** include first material layer **426**, second material layer **427**, and pads **428**, which are located between and secured to material layers **426** and **427**. Moreover, first material layer **426** forms second part **425** of the hook-and-loop fastening system, which joins with and separates from first part **415** on an underside of outer shoulder portions **413**. In other configurations, additional shoulder cushioning elements **430** may be utilized with inner shoulder portions **410**, or shoulder cushioning elements **430** may be lengthened or otherwise enlarged to extend under both of shoulder portions **412** and **413** on each side of protective apparel **400**.

A further advantage to the protective apparel **400** is that individual **10** or another athlete may incorporate various supplemental cushioning elements **440** into areas where additional padding, cushioning, or the distribution or attenuation of impact forces padding is desired. Referring to FIG. **29**, two supplemental cushioning elements **440** are depicted and may be located, as an example, under torso portion **411** and under one of inner shoulder portions **412**. More particularly, supplemental cushioning elements **440** may be located between elements **410** and **420** in these areas. In some configurations, supplemental cushioning elements **440** may incorporate both parts **415** and **425** of the hook-and-loop fastening system to join with (a) first part **415** of plate element **410** and (b) second part **425** of torso cushioning element **420**. As noted, supplemental cushioning elements **440** may be positioned in areas where additional impact force attenuation is desired. As examples, supplemental cushioning elements **440** may be located in areas that are prone to soreness or injury and areas of a prior injury. As such, protective apparel **410** accommodates the use of additional padding in any area, thereby providing individual **10** with the freedom to customize the force attenuation properties of protective apparel **400**.

Torso cushioning element **420** is depicted as primarily covering the upper and middle torso of individual **10**. In further configurations, torso cushioning element **420** may extend over other areas of individual **10**. As an example, FIG. **30** depicts a configuration wherein torso cushioning element **420** would extend over the shoulders of individual **10**, thereby replacing shoulder cushioning elements **430**. In some configurations, shoulder cushioning elements **430** may continue to be utilized in order to impart additional cushioning to the shoulders. In other configurations, torso cushioning element **420** may extend downward to cover the lower torso and pelvic region, or torso cushioning element

420 may extend upward to protect the neck. Additional plate-like components may also extend into any of these areas to impart further protection, and the hook-and-loop cushioning system may be utilized to secure the additional plate-like components to torso cushioning element **420**.

Referring again to FIG. **30**, torso cushioning element **420** is depicted as including various separate components that form second part **425** of the hook-and-loop fastening system. As discussed above, first material layer **426** may be second part **425** of the hook-and-loop fastening system. In this configuration, however, the separate components of second part **425** are secured to first material layer **426** (e.g., with stitching, adhesives, thermobonding). As such, the cross-sectional configuration may appear as depicted in FIG. **31**, wherein second part **425** is located between first part **415** and first material layer **426** when elements **410** and **420** are joined.

Shoulder pads provide one example of the types of protective apparel that may incorporate the features discussed above for protective apparel **400**. Other examples that may include plate elements and cushioning elements joined by a hook-and-loop fastening system include (a) further pads utilized for American football, (b) soccer shin guards, (c) helmets for a variety of sports, (d) hockey pads, and (e) protective devices for bicycling, skateboarding, skiing, snowboarding, and various motorsports. As another example, FIG. **32** depicts a baseball catcher's leg guard **450** that includes multiple plate elements **451** and cushioning elements **452**. Referring to the cross-section of FIG. **33**, parts **453** and **454** of a hook-and-loop fastening system may be utilized to join elements **451** and **452**. Although suited for athletic activities, protective apparel having these features may also be utilized in non-athletic pursuits, such as protective apparel for law enforcement, the military, or various other work-related activities. Accordingly, the general structure discussed above for protective apparel **400** may be utilized for various protective apparel configurations.

The invention is disclosed above and in the accompanying figures with reference to a variety of configurations. The purpose served by the disclosure, however, is to provide an example of the various features and concepts related to the invention, not to limit the scope of the invention. One skilled in the relevant art will recognize that numerous variations and modifications may be made to the configurations described above without departing from the scope of the present invention, as defined by the appended claims.

The invention claimed is:

1. An article of apparel comprising:

a cushioning element having a first cushioning-element side and a second cushioning-element side, wherein the cushioning element comprises a pad component;

a plate element, the plate element having a first plate side and a second plate side; and

a hook-and-loop fastening system, wherein a first part of the hook-and-loop fastening system is disposed on the first cushioning-element side and a second part of the hook-and-loop fastening system is disposed on the first plate side, and wherein the first part of the hook-and-loop fastening system is configured to secure to the second part of the hook-and-loop fastening system.

2. The article of apparel of claim **1**, wherein the cushioning element includes a first material layer and a second material layer, and wherein the pad component is disposed between the first material layer and the second material layer.

3. The article of apparel of claim **2**, wherein the first part of the hook-and-loop fastening system is disposed on an outward-facing surface of the first material layer that faces away from the pad component.

4. The article of apparel of claim **3**, wherein the first material layer includes a polymer sheet.

5. The article of apparel of claim **3**, wherein the pad component includes a one-piece unit comprising a plurality of connected pads.

6. The article of apparel of claim **5**, wherein the pad component includes a thickness and one or more indentions extending partially through the thickness, and wherein the one or more indentions delineate the plurality of connected pads.

7. The article of apparel of claim **1**, wherein the plate element includes a curved profile.

8. An article of apparel comprising:

a cushioning element including a pad component disposed between a first material layer and a second material layer, wherein the first material layer comprises a polymer sheet;

a plate element having a first plate side and a second plate side; and

a hook-and-loop fastening system,

wherein a first part of the hook-and-loop fastening system is disposed on an outward facing surface of the polymer sheet that faces away from the pad component,

wherein a second part of the hook-and-loop fastening system is disposed on the first plate side, and

wherein the first part of the hook-and-loop fastening system is configured to secure to the second part of the hook-and-loop fastening system to removably attach the plate element to the cushioning element.

9. The article of apparel of claim **8**, wherein the pad component includes a one-piece unit comprising a plurality of connected pads.

10. The article of apparel of claim **9**, wherein the pad component includes a thickness and one or more indentions extending partially through the thickness, and wherein the one or more indention delineate the plurality of connected pads.

11. The article of apparel of claim **8**, wherein the plate element includes a curved profile.

12. The article of apparel of claim **8** further comprising, a pelvic region with a waist opening and two leg regions extending from the pelvic region, wherein the cushioning element is arranged on a front portion of at least one of the leg regions.

13. A pants-type garment comprising:

a pelvic region;

two leg regions extending from the pelvic region, wherein at least part a leg region includes a base layer and another material layer that at least partially overlays the base layer;

a pad component disposed between the base layer and the other material layer;

a plate element;

a hook-and-loop fastening system,

wherein a first part of the hook-and-loop fastening system is disposed on an outward facing surface of the other material layer,

wherein a second part of the hook-and-loop fastening system is disposed on the plate component, and

wherein the first part of the hook-and-loop fastening system is configured to secure to the second part of the hook-and-loop fastening system to removably attach the plate element to the other material layer.

14. The pants-type garment of claim **13**, wherein the other material layer is a polymer sheet.

15. The pants-type garment of claim **14**, wherein the polymer sheet is coupled to the base layer at least partially around a perimeter of the pad component to secure the pad component between the polymer sheet and the base layer.

16. The pants-type garment of claim **13**, wherein the pad component and the plate element are configured to align with a thigh of a wearer when the pants-type garment is donned.

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